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THE PRINCIPLES
AND
PRACTICE OF PHOTOGRAPHY
FAMILIARLY EXPLAINED:

BEING
A Manual for Beginners, and Book of Reference for
Expert Photographers;

COMPRISING

THE COLLODION PROCESS;
PRINTING AND TONING;
DRY-PLATE PHOTOGRAPHY,

INCLUDING ALL THE BEST PROCESSES;

INTENSE IRON DEVELOPERS;

TRANSPARENCIES FOR THE MAGIC LANTERN;

INSTANTANEOUS PHOTOGRAPHS;

HOW TO PRODUCE LIFE-SIZE PORTRAITS;

DEFECTS, FAILURES, REMEDIES, &c. &c.

BY C. JABEZ HUGHES.

Fifth Edition, considerably Enlarged.

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PREFACE TO THE FIFTH EDITION.

THE Author is much pleased that his book has been so successful that the Fifth Edition is required in little more than two years from its first issue. The original purpose was to furnish a simple and easy introduction to photographic practice, but the work has grown under his hands: each successive edition receiving such additions, that it has expanded to a practical treatise on the Art.

The first intention—of making it a beginner's book—has been retained; hence the familiar and conversational style of the first part; but much has been written to be of practical use to the experienced photographer.

PART I. is confined to elementary principles, simple manipulations, and general advice, and is therefore addressed to the tyro.

PART II. is devoted to dry-plate photography, and comprises, the writer believes, the most complete epitome extant, embracing all the best dry processes with their workable details. This part is specially designed for amateurs.

PART III. is composed of material arising out of the daily practice of the Art, and is addressed to experienced photographers. The writer has striven to embody

in it much of his professional experience, and has always had in view a practical end. The information is such as he attaches value to himself, and therefore he thinks may be useful to others, and the endeavour is made to couch the whole in the clearest and most understandable language.

The opportunity is taken of thanking those gentlemen whose names are mentioned, and many whom are not, for publicly and privately unfolding their stores of experience. The author also acknowledges his indebtedness to those true photographic friends, the photographic journals, for the means of obtaining much of his knowledge, and he urges on all photographic students, as an excellent means of improvement, the constant perusal of these interesting records. To them is largely due the advancement of the Art, by furnishing photographers with the means of mutual communication, and recording and comparing their experiences in all matters connected with Photography.

The Author concludes with hoping that even this Manual may not be without its influence in disseminating the knowledge, and improving the practice of the Fascinating Art.

RYDE, ISLE OF WIGHT,

June, 1863.

CONTENTS.

PART I.

	PAGE
Introduction	1
Apparatus and Chemicals necessary	4
How to Prepare the Dark Room	7
How to Begin Work... ..	8
How to Take Glass Positives	11
How to Clean Glass	13
How to Take Negatives	17
How to Print on Albumenized Paper	25
How to Tone the Prints	29
How to Fix the Prints	31
How to Mount the Prints	32
How to Print by Development	32
Defects, Failures, and Remedies	33
Defects common to Positives and Negatives	35
Defects in Positives	42
Defects in Negatives	43
Defects in Paper Prints	44
Hints and General Advice	45

PART II.

	PAGE
DRY COLLODION PROCESSES	48
Remarks on Various Dry Processes	49
Washed-Plate Process	52
Washed-Plate Process, with Gallic Acid	52
Resin Process	53
Morphine Process	54
Gelatine Process	55
Malt Process	57
Tannin Process	60
Improved Method of Developing Tannin Plates	61
Tannin and Honey Process	61
Sutton's Rapid Dry Process	62
Keene's Rapid Dry Process	64
Collodio-Albumen Process	65
Albumeno-Collodion Process	69
Fothergill Process	70
Improved Fothergill Process	71
Modified Fothergill Process	72
Petschler and Mann's Process	73
Hot Water Process	74
Dr. Ryley's Modified Fothergill Process	75
Improved Method of Development for Dry Plates	77
On the Use of Hot Developing Solutions	78
Bromide of Silver Process, by Major Russell	80
Experimental Examination of Dry Processes, by Mr. H. Cooper, jun.	82

PART III.

	PAGE
Concerning Successful Photography	88
On the Use of Alcohol in the Developer	90
Intense Iron Developers	92
How to Clean Glass Plates	94
Receipts for ditto	96—99
How to Clean a Varnished Plate	99
Carte de Visite Portraits	100
Diaphragms, or Stops in Lenses	102
How to Arrange the Lenses in a Portrait Combination	104
On the Multiplication of Negatives	106
On Copying, and the Proper Lenses to Use	107
How to Construct a Copying and Enlarging Camera	108
Table of Enlargement and Reduction	110
The Solar Camera, and how to produce Life-size Portraits	112
Transparencies for the Magic Lantern	115
Cleaning and Restoring Daguerreotypes	117
Instantaneous Photography	118
Stereoscopic Pictures	121
Colouring Photographs	123
How to Recover Gold and Silver from Waste Photographic	
Materials	124
Removing Silver Stains from the Hands	129
Removing Silver Stains from Linen	130
Removing Yellow Iron Mould from Linen	130
Intensifying Processes	130
To Intensify Negatives after being Varnished	136

	PAGE
To Reduce the Intensity of Varnished Negatives ...	137
On Printing and Toning, and how to secure Good Prints...	137
The kind of Negative necessary to give a Good Print ...	141
The Necessity of Good Paper	141
Distinction between Saxe and Rive Papers ...	142
How to select a Good Paper... ..	143
Merits of various Toning Baths	145
Carbonate of Soda Toning Bath	146
Acetate of Soda Toning Bath	147
Chloride of Lime Toning Bath	149
Advantage of Occasional Variation of Formulæ ...	151
English Weights and Measures	152
French ditto	152
Fluid Measure	152

HOW TO LEARN PHOTOGRAPHY.

PART I.

INTRODUCTION.

RESPECTED PUPIL,

I PROPOSE, in a simple and familiar manner, to introduce you to the wondrous and fascinating Art of Photography. I take for granted that you are entirely unacquainted with it, and that you are anxious to learn. Before proceeding, however, to the practical portion, I wish to impress on your mind a few of the leading principles.

The word PHOTOGRAPHY means drawing, engraving, or writing by Light.

You are, doubtless, aware that white light—light from the sun, for instance—is composed of three different colours—Yellow, Red, and Blue; it also possesses three distinct properties—Illuminating, Heating, and Chemical powers. These three powers are singularly connected with the three colours. The Illuminating property exists mainly in the Yellow rays—the Heating property in the Red—and the Chemical in the Blue or Violet rays.

With the illuminating power you are daily familiar; the July sun gives indubitable proof of its Heating power; and it is your present purpose to learn that all photography is based on its Chemical power.

For the full explanation of these facts I must refer you

to Hunt's "Researches on Light;" but I mention, in illustration, that glass stained with copper and washed on one side with a colourless solution of alum, freely admits the rays of light, but obstructs 95 per cent. of heat; while a slice of black mica allows the heating, but prevents the light-giving rays to pass. Dark blue glass stops back almost entirely both heating and illuminating rays, but permits free passage to chemical or photographic power; and yellow or orange glass, on the contrary, admits light and heat, but denies passage to the blue or photographic rays.

Strictly speaking, then, it is not LIGHT—the *illuminating agency*—that is the cause of photographic action, but an active principle associated with it, and which is connected principally with the weakest illuminating and even *invisible* rays. This PHOTOGRAPHING POWER, then, that is associated with Light, but which is *not* Light, is termed ACTINISM.

The daily experience of every photographer proves, that though these two active principles, Light and Actinism, are constantly associated together, yet that they often exist in very different proportions to each other. There may be a brilliant light with but moderate actinic power, or a dull light and considerable photographic energy. In the autumn, when the sun's light and heat are at their maximum, the actinic power is by no means great. In winter though the light be rather bright, the photographic power is always dull; while in early spring, before the sun has acquired his full strength, the actinic influence is relatively the most powerful in the whole year.

But in photographing from coloured objects, these facts will be more strongly impressed on your mind. When brilliantly-lighted yellow objects "come out" dark, and dimly-

lighted blue ones appear bright, you will remember the reason; that the former reflect abundance of light, and but little actinism: whereas the latter throw back little light, but much actinism; and that Actinism, not Light, is the real picture-producing power.

The general term Photography embraces many processes of producing pictures, but the particular method I intend teaching you—the Collodion Process—has supplanted nearly all the others, it being not only the most perfect and comprehensive, but also the most simple.

Pictures by this process are taken on glass, and are either *Positive* or *Negative*. These terms will be explained hereafter, when the processes are described; and it is only necessary now, before we commence actual operations, to impress on you that photography, from beginning to end, consists of a series of delicate chemical experiments, the successful operation of which depends apparently on many minute causes, which, if attended to, will produce the desired end; but which, if neglected, either from ignorance or carelessness, will as certainly cause failure and disappointment.

You must be very exact in mixing your solutions, and in using only perfectly clean vessels to put them in.

Cultivate the habit of noticing carefully all that you do; for as there is no such thing as *chance* in photography, you must clearly understand that when you fail, you do something different to when you succeed, and that this something *causes* the failure. As your natural desire will be not to fail, you must try to discover these causes, that you may avoid them; and if you proceed in this manner you will certainly become a good and intelligent photographer.

THE APPARATUS AND CHEMICALS NECESSARY.

THE first thing is to obtain a Set of Apparatus. Beginners too frequently get a common cheap one, and are surrounded with unnecessary difficulties from this cause alone. There is no reason that the apparatus should be very expensive, but each article should be good of its kind. The quantity you will require will depend on the branch to which you devote yourself. A set for producing the usual sized Glass Positives will require the fewest articles. For the production of Negatives, and Printing from them on paper—a much higher branch of the art—more apparatus will be necessary. Should you wish to be equally well furnished for producing Portraits and Landscapes, a full equipment will be necessary. The following comprises a complete set equally adapted for all purposes, together with a list of Chemicals, the quantities being calculated for the $8\frac{1}{2}$ by $6\frac{1}{2}$ inches, or “*whole plate*” size. Should there be more articles enumerated than you think you will require, you must consult with some photographic friend, or explain to the person from whom you make your purchase the description and size of pictures you wish to take, and you will be advised what articles to omit.

A Single Achromatic Landscape Lens.

A well-made accordion-body Landscape Camera.

A light, strong, but portable Tripod Stand for ditto.

A travelling Glass Bath with water-tight top.

A portable Dark Tent, for working in the open air.

A Double Achromatic Portrait Lens, fitted with “*Water-house*” central diaphragms.

A substantial square Mahogany Camera for in-door work.

A strong, well-made Camera Stand for in-door work.

- A Head-rest for attachment to chair-backs.
- A strong Iron ditto for standing figures.
- Three plate boxes, 24 grooves, to suit the sizes of the camera.
- Patent plate-glasses to fill the above.
- Set of scales and weights, with glass pans.
- 1 plate-cleaning holder.
- 1 or more stout oak printing frames.
- 1 Pneumatic plate-holder for large plates.
- 1 Developing stand for ditto.
- 2 or more Porcelain dishes.
- 1 Gutta-percha tray, to be used for Hypo-sulphite of Soda only.
- 1 Large and 1 small glass funnel.
- 1 Gutta-percha funnel, medium size.
- 1 each 20 oz., 5 oz., 2 oz., and 60 minim, graduated glass measure.
- 1 Four oz. tall graduated collodion bottle.
- 1 Diamond for cutting glass plates.
- 1 Horn and 1 boxwood pincers.
- 1 Silver-bath meter, for estimating the strength of silver solutions for Bath or printing.
- A few glass stirring rods.
- Linen cloths, and clean chamois leather.
- A few wide and narrow-mouthed bottles.
- A black velvet focussing cloth, about one yard square.

LIST OF CHEMICALS.

- 20 oz. Bromo-Iodized Negative Collodion.
- 20 oz. Positive Collodion.
- 5 oz. Re-crystallised Nitrate of Silver.

6 THE APPARATUS AND CHEMICALS NECESSARY.

- 1 oz. Pyrogallic Acid.
- 1 oz. Citric Acid.
- 1 lb. Proto-sulphate of Iron.
- 1 lb. Hypo-sulphite of Soda.
- 15 Grains Chloride of Gold.
- 4 oz. Kaolin.
- 4 oz. Cyanide of Potassium.
- 5 oz. Glacial Acetic Acid.
- 5 oz. Alcohol.
- 1 Bottle Crystal Varnish.
- 1 Ditto Spirit do.
- 4 oz. Acetate of Soda.
- 1 oz. Bi-carbonate do.
- 1 Bottle Black Varnish.
- 1 Ditto Plate-cleaning Solution.
- 1 Quire highly Albumenized Paper.
- 1 „ white Blotting Paper.
- 1 Book Litmus Paper.
- 1 Packet of large round Filter Papers.
- 1 Ditto small.

It is not necessary that you should get the chemicals in exactly the quantities given above, and for sizes below $8\frac{1}{2}$ by $6\frac{1}{2}$ in., smaller portions will do; yet it is not well to begin with too small a stock, as from your inexperience you will be very apt to spill and waste a quantity at first; and if you reside in a country district you may experience a difficulty in obtaining articles sufficiently pure for your use. As a rule, it is better to buy them of those persons who supply photographic materials, from whom you will obtain them cheaper and better than from local chemists and druggists.

HOW TO PREPARE THE DARK ROOM.

HAVING selected your Apparatus and Chemicals, the next thing is to prepare a room in which to conduct your principal operations. This is technically called a *dark room*, though, except in a chemical sense, there is no reason that it should be very dark.

Many persons imagine that any cupboard or out of the way corner will do to prepare plates in; this is a mistake, and if you can select a room sufficiently large in which you can move about freely, it will be much better than being cooped up and crippled in your actions. Moreover, in warm weather, the fumes from the chemicals will be injurious to your health, if the chamber be too small and ill-ventilated. Everything that can be spared should be removed from the room, and nothing allowed to remain that can be injured by chemicals being spilt. It should be kept very clean, for dust and dirt are great enemies to good photography. Oilcloth or bare boards are best for the floor, not carpet. A convenient range of shelves should be made round the room, and some hooks provided for hanging cloths and towels on.

You will remember I explained that the Actinic force that accompanies Light resides mainly in the blue, and scarcely at all in the yellow rays; and photographers ingeniously take advantage of this fact by illuminating their "dark" rooms with this non-photographic light, and thus see how to prepare their most sensitive plates. Every aperture and chink that admits white light must be carefully stopped up.

If there be more windows than one, they must be blocked out, and the remaining one covered with three folds of yellow calico; or, better still, have a hinged frame made to cover

the window, and glaze this frame with dark yellow or orange glass, so that you can have yellow or white light in your room at will. If a window is not obtainable, a gas light, a lamp, or even a candle may be used, if a yellow glass be provided. An ordinary moderator lamp, with a yellow paper screen over it, makes a very fair light for the *dark* room. Persons usually make the room for preparing their plates too dark. This is a mistake; at least sufficient light should be admitted to enable you to see what you do, but it is important that this light be quite yellow. Should you commit the error of admitting too much light, you will find under the head of "Defects, Failures, and Remedies," the proper method of proceeding.

Near the window or lamp, a strong shelf or table should be placed, to hold the bottles which you will require, and close at hand you must have a supply of water. If you can have the water laid on, with regular tap and sink, your arrangements will be perfect; failing this, you may have a cask or other vessel with a tap in it, filling it up with water as you need, or on an emergency use a jug, and a pail to receive your slops. Have a towel and soap conveniently placed to wash your hands with.

HOW TO BEGIN WORK.

YOUR room being prepared, you are ready to make a commencement, and your natural desire will doubtless be to take a portrait.

But as you are a beginner, you should commence with the easiest thing, and to take a portrait well is one of the most difficult in photography. The proper proceeding is to set up a plaster cast, engraving, porcelain statuette, or similar still-

life object, and practice upon it, being prepared for many failures arising from your ignorance and clumsiness, before you attempt portraiture. You should try picture after picture, noticing carefully the faults you commit in one, so as to avoid them in the next.

In this way by patience, observation, and practice, you will speedily gain such experience as will make your new occupation a pleasure. Above all things do not expect to produce good pictures all at once; and be not discouraged with failures, but try to understand why you fail.

In setting up an inanimate object to copy, the risks of failure are less, for it will not move or alter its expression, or make remarks if you do not succeed. When brother Tom, or friend Harry is called in to sit, the case will be different; they will be full of fun and jokes, will most likely move at the critical moment, and say disparaging things when they find the picture a failure. All this will confuse you, and cause you to omit things you ought to have done, and do abundance of things you ought not to have done, and dishearten you in your early progress.

You had better, therefore, set up a plaster cast bust—one painted stone colour will be best—such as those of Shakespeare, which are so abundant, and, using this as a model, work frequently at it, until you have sufficient mastery of your instrument and materials to produce, with moderate certainty, a passably good picture; then you may proceed to portraiture.

Place your object in a good light, a glass-house built for the purpose is the best, but this you may not at present be able to obtain. A well lighted apartment will do, if you use a white screen—a sheet thrown over a clothes-horse—to reflect light upon the shaded side. A background may

be formed by hanging some quiet drapery a little distance behind your object.

Now get out your portrait lens, and after wiping carefully the surfaces of the glasses with a clean silk handkerchief or chamois leather, screw it on to your portrait camera, and place them both on your heavy camera stand opposite to your object. The ground-glass of your camera should have the sizes of the glass plates marked on it in squares, corresponding to the holders in your dark slide. Place your stand and camera so that the lens is opposite to about the centre of your object, and move the stand and camera backwards or forwards until the image of the bust is of the size, and occupies the place on your ground-glass that you wish the image to do on the plate you are going to use, remarking that the nearer the camera is to the object, the larger the object will be, and *vice versâ*. Lay the focussing-cloth on the camera; put your head under the cloth, and you will more clearly see the image on the ground-glass. Slide in or out the inner body of the camera until the image is seen quite distinctly, then fix the camera with the screw provided. While your head is still under the focussing-cloth, pass your hand round to the lens, and move the rack backwards and forwards till you find the point at which it is most distinct. It is then said to be "in focus," or "sharp."

You may now return to your dark room, and prepare your chemicals for "Glass Positives," these being the most easily produced photographs.

HOW TO TAKE GLASS POSITIVES.

THE chemicals required are—

Positive collodion.

Nitrate of silver solution.

Plate-cleaning do.

Developing do.

Fixing do.

Crystal Varnish

Black do.

The Positive Collodion you will purchase ready prepared. When required for use, pour three or four ounces into the tall collodion bottle; and when you have done for the day return what remains back into the stock-bottle, that it may settle with the rest. In this manner you always use from a clear quantity, and avoid those spots and defects which arise from a turbid or unsettled collodion.

The nitrate bath solution is one of the highest importance. To know how much solution to mix, fill your bath with water to within an inch of the top, and measure how much it holds. Suppose it to contain 25 fluid ounces;* as 35 grains

* It is important to notice that in all photographic formulæ, where ounces of fluid are named, that *fluid* ounces are meant, and that the glass measures are graduated for the purpose. When solids are named, *Apothecaries* weight is meant. But the materials are sold to you by *Avoirdupois* weight; and as the ounce of the latter is not so heavy as that of the former, this fact must be carefully remembered, or disputes with shopkeepers, and errors in mixing your solutions will arise. The Apothecaries ounce weighs 480 grains, and the ounce Avoirdupois but $437\frac{1}{2}$ grains. It is better, therefore, in mixing nitrate of silver solutions, to estimate the quantity required in *grains*, remembering that the purchased ounce of nitrate of silver will never contain more than $437\frac{1}{2}$.

of nitrate of silver to one fluid ounce of distilled water is the proper strength, 2 ounces of the nitrate will be required to form 25 fluid ounces of the necessary solution. Dissolve the silver in 4 ounces of distilled water, or boiled rain water, then add half an ounce of positive collodion to it, shake it well for a few minutes, and add 21 ounces more of distilled water.

The solution will now be a pale milky colour, and requires filtering. Should it not run through quite clear it must be re-filtered. Add one drop of pure Nitric Acid to every 3 ounces of nitrate solution, and then it will be ready for use.

DEVELOPING SOLUTION.

Proto-sulphate of iron	...	...	100	grains.
Glacial acetic acid	...	...	$\frac{1}{2}$	ounce.
Water	...	...	10	ounces.
Nitric acid	...	...	5	minims.
Alcohol	...	...	$\frac{1}{2}$	ounce.

Dissolve the crystals, and if the solution be not quite clear, filter it, then add the alcohol and acids. It will keep good a considerable time.

FIXING SOLUTION.

Cyanide of Potassium	...	...	60	grains.
Water	...	...	6	ounces.
Dissolve and it is ready for use.				

Let each of these solutions be distinctly labelled, and cork them well when they are out of use.

HOW TO CLEAN THE GLASS.

Certain fixed sizes are used by photographers, and the glasses are sold cut ready for use.

The description of glass known as "Flatted Crown," is well suited for positives, but, before using, it requires carefully cleaning. The sharp edges should be first removed with a fine file, or by drawing the edge of one piece over the edge of another; then lay the glass on a clean flat surface, or put it in a "Plate-cleaning holder," and pour a few drops of the "Plate-cleaning solution" in the middle. Rub it carefully over every part with a bit of clean soft rag: turn the glass over, and do the other side the same. Then polish each side with a clean cloth, and finish with a soft chamois leather kept expressly for this purpose. Now breathe on the glass; and if the breath deposits evenly, the plate is clean. If the plate, however, shows patches and marks, it must be re-cleaned. Let the edges be carefully wiped, and the plate is ready for use. This amount of cleaning will generally be sufficient for new glasses, but when they have been used they require more labour. They must then be well washed under the tap, to get rid of all collodion and chemicals, and be wiped on cloths kept expressly for the purpose. No soap, only plain soda and water, must be used in washing these cloths. Should the plates have been varnished, they must be soaked for some hours in a saturated solution of washing soda, till the varnish and film come freely off. The glasses must then be well washed, and treated as already described. It is a good plan to have a dish of water at hand, into which to place the spoilt pictures, and at the end of the day to wash them all, and put them away clean. By thus not allowing

the films to dry on the glasses, they are much easier cleaned and fewer failures will arise from dirty glasses.

Collodion is a very good material for cleaning glasses when they are not very dirty. Pour a few drops on the glass, and well rub it with a clean cloth, and you will entirely remove all grease. A hint may be taken from this how to use up waste collodion.

POURING ON THE COLLODION.

Remove the stopper from the bottle, and wipe from the lip any dust, or dry film adhering; and holding the plate horizontally by one corner with the thumb and finger of the left hand, pour steadily into the middle of the plate as much collodion as will half cover it. Then gradually incline the plate so that the collodion flows to each corner, not allowing it quite to touch the thumb; then steadily pour back the excess from one corner into the bottle, and while the plate rests on the mouth of the bottle, move the plate backwards and forwards to prevent the collodion setting in lines. Perform this operation coolly and steadily, and try to avoid spilling any of the collodion. A little practice will make it easy. When the collodion is set, usually in a few seconds, the plate is ready to be immersed in the nitrate of silver bath. Lift the dipper up, and place the back of your plate on it—it will adhere by capillary attraction—and immerse plate and dipper into the bath solution with one steady dip, and cover it over to keep it from light and dust. If there be the least hesitation or stop while the plate is being immersed, there will be a line marked across the plate. To know how long to keep the plate before putting it in the bath, after it is collodionized, is a point that you will gain by experience; but it depends

on many circumstances, such as the nature of the collodion and the temperature; but this rule will guide you: if you put the plate in too soon, streaks and marks will be formed, commencing from where it first touched the silver solution. If you do not immerse it soon enough, the part of the plate that has become too dry will be insensitive, and will show a dark mark. By noticing these points, you can judge whether you have made an error in the time of immersion. The plate must remain in the bath in summer time about two minutes, and in winter from five to ten.

While the plate is in the bath, you must get ready your dark slide, and see that there is no dirt in it. Up to this point you may use white light; you must now shut your door, and see that only yellow light illuminates the room. Lift the plate up and down in the bath several times by means of the dipper, and the agitation of the solution will remove the oily-looking lines on the surface. Allow it to remain in the bath till all apparent greasiness is removed, and the film has become creamy-looking. Then take it off the dipper, and handling it as carefully as possible, chiefly by the corner uncollodionized, let it drain on clean blotting paper, and then lay it, collodion side downwards, into your dark slide, the silver wire corners supporting it by the four corners. Close up your dark slide, and your plate is ready for use.

You may now return to your plaster cast, and insert the dark slide in the place of the ground-glass frame. Cover the lens with the cap, raise the shutter of the dark slide, and gently remove the lens cap, so as not to shake the camera: thus the light will be admitted to the sensitive plate. Experience can alone determine the length of the "exposure."

The brilliancy of the light, colour of object, kind of lens, nature of collodion, time of day, and even the period of the year, are all modifying circumstances.

Suppose you allow ten seconds. Count the time exactly, and replace the cap on the lens. Next shut down the shutter of the slide, and take it into the dark room. Close the door, and, noticing that no white light is admitted, remove the plate carefully from the dark slide. The nitrate solution that has accumulated at the bottom, drain off with clean blotting paper. Put about an ounce of developing solution into a clean measure glass, and holding the plate horizontally by the bare corner, collodion side upwards, pour steadily but quickly along the bottom edge of the plate sufficient to easily cover it; gently incline the plate to allow the developing solution to flow uniformly backwards and forwards. Watch the "coming out" of the image. The image will quickly appear, first the parts most strongly lighted will show themselves, next the shaded portions, and when these are fully out, turn off the solution, and wash the plate well, by allowing the water from the tap to flow over it for not less than one minute, or until all the greasy lines disappear.

Lay the plate in a shallow gutta-percha dish kept for the purpose, and pour quickly over it sufficient of the fixing solution to cover it. Directly the yellow film of iodide of silver is dissolved, the plate must be lifted out and well washed. When the plate goes into the fixing solution, white light may freely be admitted. The fixing solution must be put back into its bottle, and may be used as long as it continues to dissolve the yellow film.

If the exposure be correct and you have developed pro-

perly, you will now have a nice picture of your bust.* Your plate may be dried spontaneously or by heat. When dry, pour on the *glass* side jet black varnish just as you did the collodion, and drain off at one corner, taking care it does not flow over to the face of the picture; or, better and easier, use a black varnish made expressly for the purpose, which is to be laid on with a brush, and which dries quickly or may be assisted with heat. The collodion surface now requires varnishing to protect it from atmospheric action. Remove carefully with a camel-hair brush any dust or dirt on the picture, and pour crystal varnish over it as you did the collodion. Drain it, and when dry, your picture is finished, and ready to be mounted.

You have now passed through the various operations, and it only requires practice and observation to make them familiar with you. Having obtained this practice, the bust may be removed, and a friend being placed in its stead, you may, by applying the same manipulations, produce a portrait. Let him sit in an easy, graceful position, and, if necessary, steady his head by the use of the head-rest. Let him look at some dark object, and allow him to wink his eyes freely during the sitting, but caution him to be quite steady in all other respects.

HOW TO TAKE NEGATIVES.

THE pictures produced by the above method have the disadvantage that a separate sitting is required for every one; this, together with the fragility of the material, has caused the process to be less generally followed than the more

* If the picture be not perfect, refer to the chapter on Failures for further instruction.

complex one, where a *negative* is first obtained from which an indefinite number of paper pictures can be produced. The practice, however, you acquire in producing glass positives will be extremely useful in producing negatives, as, up to a certain point, the manipulations are similar.

You must clearly understand the difference between a Negative and a Glass Positive. Every glass picture, to a certain extent, partakes of the nature of both; but a positive is a picture done at one operation, and complete in itself, whilst a negative is not so much a picture as the means of producing one.

Glass positives are examined by reflected, negatives by transmitted light—the one you hold *down* to look *at*, the other you hold *up* to look *through*;—the former is black-varnished to make it opaque, the latter clear varnished to give transparency. The one shows natural objects as they are—lights for lights and darks for darks—the other, just the reverse, faces, hands, and linen very dark, and black drapery quite clear. Hold a picture of each kind up to the light and look *through* them, the positive will appear thin and transparent, the negative dense and opaque; turn them down and look *at* them, the positive is clear and distinct, the negative misty and confused. The two kinds of pictures are so different, that you must judge each by its own rules; for what is a fault in one, may be a merit in the other. In other words, a negative is a glass picture produced by somewhat similar means to a positive, only that in the development a much thicker and denser deposit is formed.

In fact, the negative is to the photographer what the types are to the printer; and as the latter, you know, are arranged just the contrary of the impression that is taken from them, so must the photographer's negatives—his

types—be the reverse of his prints. The analogy between the two processes is so considerable, that the production of paper pictures by the aid of negatives is always termed “printing.”

It will be a great assistance to you, if you can obtain from some photographer a negative that you can keep by you, to compare with your own, until you have acquired experience to know how to judge for yourself.

The same apparatus serves for the production of negatives as positives, but some of the chemicals are different; those that you require are—

Bromo-iodized negative collodion

Nitrate of silver bath solution

Developing do.

Fixing do.

Spirit varnish.

The *Bromo-iodized Negative Collodion* is rather different in its preparation to positive collodion, and is better adapted for giving dense pictures. It is often supplied as plain collodion and iodizing solution. It is made ready for use by mixing three parts by measure of the former to one of the latter. It is better to mix it a few hours before using, so that time be allowed for floating particles to subside.

Nitrate of Silver Bath Solution.—The same you used for positives will not do for negatives.

Recrystallised Nitrate of Silver ... 2 ounces

Distilled or boiled rain water ... 25 „

Dissolve the silver in four ounces of the water; dissolve 2 grains of iodide of potassium in one ounce of the water, and add it to the four ounces of silver solution; agitate till the

yellow precipitate first formed is dissolved. Add a few drops of a saturated solution of bi-carbonate of soda, agitating well between each addition, until the silver solution becomes quite milky, then add the remaining 20 ounces of distilled water. Filter, and add half a drachm of glacial acetic acid, and your nitrate bath is ready for use. Fill it up from time to time with a plain solution of nitrate of silver, 40 grains to the ounce.

DEVELOPING SOLUTION FOR NEGATIVES.

Protosulphate of iron	...	...	150 grains
Glacial acetic acid	...	...	$\frac{1}{2}$ ounce
Alcohol	...	...	1 „
Distilled water	...	...	10 ounces.

This solution gradually acquires a sherry colour, but its quality remains equally good. It should be filtered before using.

FIXING SOLUTION.

Hyposulphite of soda	...	...	5 ounces
Water	...	...	5 „

This solution may be used until it loses its power of fixing the negative. It soon becomes discoloured, but that is of no consequence.

“Patent Plate” is the proper glass to use for negatives, as the “crown” is not flat enough. It requires the same careful cleaning as for positives. As it is more difficult to produce clean negatives than positives, you had better accustom yourself to use a glass one size larger than you require, so that any defects, which usually occur on the margin of the plate, may not spoil your picture.

Pour the collodion on your plate, sensitize, drain, and place it in the dark slide as carefully as for positives.

The same difficulty occurs with negatives in giving any rule for the length of exposure; the appearance of the plate during development being a useful guide, but they always require twice as long time as for positives. Be very careful when your plate is in the dark slide, to keep it erect, and to handle it gently. Never knock it against anything, or it will be covered with abundance of spots from particles of dust and dirt falling on it. When in the dark room, take the plate out as carefully as before, and remove, with clean blotting-paper, the nitrate solution that has accumulated at the bottom; and holding it by the corner, pour over it the developing solution, and in a few seconds the image will appear. After a little experience you will be able to judge, by the manner in which the image makes its appearance, whether you have given the proper exposure in the camera.

If it start out at once, directly the developer has flowed over the plate, the exposure has been too long; but if the image comes out slowly and reluctantly, and you have difficulty in making the deepest shades appear, it has not been exposed long enough.

The happy medium between these two is the correct time. When this has been given, the image makes its appearance steadily and gradually, first the high lights, next the light shades, and finally the deep shadows. Suppose it a portrait of a gentleman—the shirt front, face, and hands are first seen, the light folds of the drapery next show themselves, and lastly, the details in the darkest parts. If it were a positive, you would have poured the developer off before these last were seen; but being a negative, you must carry it on until the whole of the details are clearly out, then pour the solution

off the plate into your measure-glass, and hold your plate up to the light and look through it. You will now see the image as a negative, the whites all dark, and dark portions nearly transparent; and if the picture appear in proper harmony, making allowance for reversed effects, the lighter portions nearly opaque, and the darker parts very clear—but *the whole picture full of gradations and half-tones, with scarcely any parts entirely opaque, and very few clear glass*—the development is completed; if, however, the picture presents somewhat this appearance, but be deficient in opacity of deposit or “density,” then pour off the iron solution, and wash the plate well. Next pour over the plate as much as will comfortably cover it of the following:—

NEGATIVE INTENSIFYING SOLUTION.

Pyrogallie acid	...	...	...	3	grains
Citric do.	...	...	...	1	grain
Glacial acetic do.	...	...	...	$\frac{1}{2}$	drachm
Distilled water	...	...	...	1	ounce.

When this solution has thoroughly mixed with the water on the plate, pour it back into the measure-glass, and add a few drops of nitrate of silver solution to it, 30 grains to the ounce of water, mix, and pour again over the plate; the image will speedily begin to intensify, that is, the silver will be deposited over the various parts where the light has acted. This intensifying must be continued until the parts of the negative most lighted have the requisite opacity.

This solution sometimes becomes turbid and muddy before the picture is dense enough. In such a case, pour it away and renew with some fresh intensifying solution and silver,

and proceed as before. This may be repeated many times, if needed, until the required effect is produced. Here is, perhaps, the most difficult thing you have to learn—to know how far to go, and when to stop; how to gain intensity enough to produce a vigorous negative, and yet to avoid making it too dense, and losing half-tone. As a rule, beginners over-develop their positives, and under-develop their negatives.

But it is possible to intensify too much, and make the picture so dense that you cannot print through it. You must watch the kind of prints that different negatives produce, and when you find one that gives a brilliant yet soft image—for the real test of a negative is the kind of print it produces—study that negative well, observe the degree of opacity it has, and, keeping it as a standard, try and produce all others like it. In this way you can train and educate yourself to produce good negatives.

The development being finished, wash the plate and lay it in the gutta-percha dish; pour the fixing solution over, and when the yellow iodide is dissolved out, give it a careful and copious washing; for if any of the hyposulphite of soda remain in the film, it will crystallise and spoil it.

Your picture now being washed, you may calmly examine it. If it show as a moderately good but over-exposed positive, with a red and green pearly tint, and on looking through it abundance of half-tones, both in the opaque and transparent parts, are seen, you may consider you have a correctly-exposed and well-developed negative, and one from which you may anticipate brilliant prints.

If, however, the negative appear as a good positive with brilliant blacks, but rather chalky whites, and on looking through it these latter are very dense without half-tone, and

the former almost like bare glass, then your picture is defective, and will only produce a hard black and white print. The fault being that it was not long enough exposed in the camera.

Should it, however, appear as a very much over-exposed positive, the whole plate having a grey film over it, obscuring the image, and on looking *through*, the details of the shadows are almost as intense as the white linen, and the whole picture is deficient in contrast, then it has been over-exposed.

The two instances I have pointed out are extreme ones; it is your object to avoid each, but of the two errors, under-exposure is the worst, for by careful printing you may get a passable proof from an over-exposed negative; but no dexterity will avail with an under-exposed one, and unfortunately, beginners' negatives, from their great desire to "work quick," have too frequently this latter fault.

HOW TO VARNISH THE NEGATIVE.

AFTER the plate has been well washed and dried, it is ready to varnish. If only a few prints are wanted, and you do not intend to keep the negative, you may use crystal varnish. If, however, you value your negative, and purpose producing many prints from it, the crystal varnish will not give sufficient protection, and you must use a spirit varnish. There is a French article, *Soëhnée* (pronounced *sennay*) varnish, that is very good indeed. To use this, or any other spirit varnish, warm the negative before a fire uniformly all over, as hot as the back of the hand will bear, then pour the varnish on like collodion, drain off, and dry it with a similar heat. When cold, your negative is ready to be printed from.

HOW TO PRINT ON ALBUMENIZED PAPER.

THE remark has been made that a *negative* is not so much a picture as the means of producing one, and your next proceeding is to use the negative to produce an impression on paper. This operation is called "printing," and the paper picture produced is termed a "print." There are two kinds of paper employed, plain and albumenized. The former yields a dull surface like an engraving, and is chiefly used for pictures that have to be coloured; the latter has a glazed surface, and is the kind in general use for almost every kind of photograph, as it gives a more brilliant picture, and yields finer definition.

The apparatus necessary for printing are—

Printing-frames.
Porcelain dishes.
Silver-bath tester.
Gutta-percha dish.
American pegs.
Boxwood pincers.

The materials required for the operation are—

Albumenized paper.
Plain salted do.
Nitrate of silver solution.
Kaolin.
Chloride of gold.
Acetate of soda.
Hyposulphite of soda.

Albumenized Paper.—This material you can purchase ready prepared. There are two principal kinds known as *Rive* and

Saxe. The former is a French paper, and has the highest glaze and finest surface; but the latter, a German one, is the most uniform in its general texture.

Plain paper requires preparing, or "salting," before being ready for use, or it may be purchased already salted. It is not a difficult thing to "salt" your own paper. Procure some sheets of *Saxe* paper, and immerse them for five minutes, removing air bubbles, in the following solution:—

Chloride of ammonium	...	...	100	grains
Chloride of barium	...	...	100	"
Citrate of soda	...	...	20	"
Water	...	...	20	ounces.

Hang the sheets up to dry, and they are ready for the next operation. This may be performed in ordinary daylight.

Nitrate of Silver Solution.—You must make a fresh silver solution, as the one you have used for your positives and negatives is not adapted for printing, neither will the one you are about to make serve the former purposes, each must be kept for their separate uses. Measure how much fluid one of your porcelain dishes contains when filled half an inch high, and make so much nitrate of silver solution, 60 grains to the fluid ounce. The crystals have simply to be dissolved, and the solution is ready for use. It speedily becomes discoloured; but if you adopt the plan of keeping some kaolin, an ounce or two, in a bottle, and pour your silver solution into it after each time of using, shaking it up well, the kaolin in subsiding will carry down with it the colouring matter. This solution rapidly loses its strength, therefore, each time before using immerse the silver-bath meter, and note the figure on the tube where the surface of the fluid touches, and it will indicate the number of grains of nitrate of silver con-

tained in each ounce of solution. Thus, if it stand at 30, 40, or 60, each ounce may be considered to contain so many grains of the nitrate. You must never sensitize your paper without being assured that your solution contains 60 grains per ounce. It is not sufficient that you originally mix it this strength, but it must be continued so, and until you have experience, you will scarcely believe how rapidly the silver salt is abstracted by the act of sensitizing the paper. If you adhere to the use of this little instrument, you will always be kept right; but never forget, that if this solution be not kept up to this strength, you cannot obtain brilliant and vigorous prints.

Chloride of Gold.—This valuable substance is generally sold in bottles or tubes containing 15 grains. It is very deliquescent, and unless hermetically sealed, can only be kept in solution. Break your tube, and dissolve the contents in a bottle containing two ounces of water, and label it accordingly.

Hyposulphite of Soda.—Dissolve two ounces in eight ounces of water, and label the solution. Make a fresh quantity for every batch of prints.

HOW TO SENSITIZE THE PAPER.

FILL your dish to the depth of not less than half-an-inch with the 60-grain nitrate of silver solution already named. Cut your paper to convenient sizes suitable to your negatives, and lay it glazed or albumenized side downwards on the surface of the silver solution. When it has lain for about a minute, with the pincers lift up one corner, and if there are any air bubbles remove them; replace the sheet, and allow it to remain five minutes on the solution, then lift it off, taking care no solution runs over the back, and suspend it with an

American peg to a line in a closet or other dark place, where it can dry spontaneously. It is ready then for use.

Your paper ready, place your negative in the printing frame, collodion side uppermost—be sure the glass is quite clean—and lay the paper on it, prepared surface downwards; put a few sheets of blotting paper behind it, next put the hinged back in its place, and secure the whole tightly with the screws or other fastenings provided.

It is essential that the paper should be in very close contact with the negative to produce a “sharp” print, and you must observe that this pressure is uniform, to prevent breaking it.

Expose it to the light, and allow it to remain until printed. How long this operation will take depends on the power of the light and the density of the negative. In summer, a very short period is sufficient; and in winter, a whole day or longer may be required. To know how it is proceeding, undo the fastenings *on one side of the frame*; and by lifting up the hinged back, you can, without disturbing the position of the negative and paper, examine the latter, and observe its progress. First, the general outline is marked; then, the deep shadows; next, the lighter shades; and, finally, the delicate half-tones. By these latter you must be guided. You must print till they are not only clearly out, but a few shades deeper than you would like them, because in the subsequent operations they will become lighter, and unless you make this allowance, your print, when finished, will not be deep enough. A little experience will tell you how dark you should print. In printing portraits you must judge entirely by the *head*; get out all the half-tones clear and distinct, so that the ultimate picture shall show the features nice and round, not buried in black shade from being over-

printed, or pale and flat from under-printing, but just such soft gradations as will make a pleasing likeness. This depth obtained, take it out of the printing frame, and it is ready to be *toned* and *fixed*. The operations of preparing the paper, putting it into the printing frame, examining it and taking it out, together with the toning; should all be done either in yellow or very dull white light; for although the excited paper is not nearly so sensitive as collodion, yet a strong light, especially sunshine, will quickly spoil it for good printing.

HOW TO TONE THE PRINTS.

If you are producing several prints you may wait till they are all ready, keeping those first done in a drawer or other place secluded from light, but they should be toned and fixed the same day they are printed; for, although these operations may be deferred, the results are seldom so good. When ready, immerse them in a dish of clean water, removing air bubbles, and move them about that the water may get freely between; allow them to remain five minutes; pour the water away and refill the dish, and again wash for another five minutes, moving them about as before, change the water a third time: this last time the water should only be slightly milky; if it is more than this, the prints must be further washed.

TONING BATH.

Chloride of gold	...	...	15 grains.
Acetate of soda	...	...	1 ounce.
Distilled water	...	...	40 ounces.

This bath may be mixed in the above quantity, as it will

keep for a considerable time. It should be prepared a day or two before being used. When required for use, pour enough in a dish to well cover the prints. Take the prints from the last washing water, and immerse them one at a time; keep them moving about, and remove air bubbles. Until you acquire experience, you had better not have more than three or four prints in at a time. They must be closely watched, for they speedily change from their reddish brown to a purple tint; and if they have been printed deeply enough, the shades will pass to a purple black, while the whites will assume a delicate rosy hue. Some little experience is required to know when to take them out, but you may be guided by the general appearance as seen by looking *through* them, holding them up to the light. If they are purple when thus examined, they may be removed into a dish of clean water, to remain until they are all toned, and ready to be fixed.

According to the depth to which you have printed, and the length of time they have been in the toning solution, so will the colour be. If you wish a rich chesnut brown, a very little toning will suffice; if you like a purple brown, tone deeper; and if a dark purple black, you must print and tone very deep. The colour of your prints will materially depend on your negatives. With a well-defined, soft, yet vigorous negative, you may produce any tone; but from weak negatives you cannot produce good pictures. Prints kept too long in the toning solution become cold, grey, inky, weak, and flat.

If you are attentive, you will quickly gain experience enough to get with good negatives almost any desirable tone, by modifying the depth of printing and strength of toning. The time usually occupied is from two to five minutes. In winter time the solution may be warmed, and it will tone quicker. The preceding instructions are mainly directed to

highly albumenized prints; a little modification is required for plain paper proofs; they should be printed rather darker, as they have a great tendency to bleach during toning. The toning solution should be much more dilute than for albumen prints.

HOW TO FIX THE PRINTS.

INTO your gutta-percha dish—which you must keep expressly for this purpose—pour your fixing solution of hyposulphite of soda. Immerse your prints in it, and allow them to remain for fifteen minutes, separating and moving them about, so that the solution may get freely to them all. Fresh fixing solution should be used each time, as it is unsafe to use it a second time until you have had considerable experience.

The prints will quickly change and lose some part of the beautiful hue they had in the gold solution, but this tint will be restored when they are finally finished. When the time has elapsed, they must be taken out, well drained, and then be well washed to rid them, as much as possible, of the fixing solution. For the first half-hour they should be kept in running water, and, if your circumstances will permit, should be kept in for six hours, and finally soaked in hot water, and then dried. If you cannot give them the advantage of a running stream, change the water in which they are soaked every half-hour for the first three hours; then soak them all night, and next morning give them two or three changes, and finishing with hot water, let them be dried. This well washing is a security that your prints will not fade, for more are spoilt from neglect of this important but irksome process than from any other cause.

HOW TO MOUNT THE PRINTS.

WHEN dry, the print will be very curly ; but if ironed on the back with a clean warm flat iron, it will lie smooth, and then it may be cut and trimmed as taste dictates.

Hot thin glue may be used to mount them on cardboard ; but starch, such as used for household purposes, and about the same consistency, is equally adapted. It should be used cold. To complete them they should be sent to the hot-pressers, who, for a very small charge, will glaze or roll them, which will communicate a highly-finished appearance.

HOW TO PRINT BY DEVELOPMENT.

ANOTHER mode of printing is occasionally adopted where light only commences the operation, and the further production of the picture is by development. There are many circumstances in which this mode is very useful, especially when the solar light is too weak to produce prints in the usual manner.

The results are not quite so fine as by direct sun-printing, and are best adapted for large and bold subjects.

Albumenized paper is not used, but salted paper, which you may purchase ready for use, or prepare for yourself as follows :—

Chloride of ammonium ... 90 grains.

Water ... 10 ounces.

Immerse the paper—Towgood or Saxe is best—for five minutes, then hang up and dry ; sensitize on the following bath according to the directions previously given :—

Nitrate of silver ... 45 grains

Glacial acetic acid ... 3 minims

Distilled water ... 1 ounce.

When dry, expose under a negative till a very faint picture is seen, then take it into the regular dark room, and place it in a very clean dish, pour over it a saturated solution of gallic acid. It will take from five to twenty minutes to develop. When the print is fully out—you must get rather a strong impression, as it loses a little in fixing—wash it well in plain water, changing two or three times, then immerse in the hyposulphite fixing bath, already named, for other prints. Allow it to remain ten minutes, then wash well, obeying all the instructions already given on page 31. Prints produced by this formula are a very good colour, and do not need toning.

DEFECTS, FAILURES, AND REMEDIES.

“ Humanum est errare.”

MY WORTHY PUPIL, in the preceding instructions I have been as clear and as simple as I could, and have avoided explanations that, in your early progress, might embarrass you; that you may be successful is my ardent wish; yet, as there is no royal road to photography, it is more than probable that you will be beset with many of the troubles common to the practice of the art.

It may be a melancholy satisfaction to know that the cleverest practitioners are subject to them in common with the less skilful; the difference, however, being, that the former by perseverance overcome them, while the latter give up the contest and are beaten.

If, however, there were no difficulties to be surmounted, there would be no credit in excellence, and one of the stimu-

lants to advancement would be denied to the student of photography. Such, however, is not the case, as the difficulties that constantly arise afford abundance of opportunity for the exercise of ingenuity, intelligence, and patience. It is sufficient to say, if you meet with few of them, deem yourself fortunate; and, if you encounter many, be not discouraged, but strive to overcome them.

Generally speaking, to point out the origin of a defect is also to suggest a remedy. It is impossible to anticipate where your difficulties will be, for the experience of no two exactly agrees, but you must endeavour to *understand* the process and to grasp the *spirit* of the directions. Above all things resolve to be neat and clean in your manipulations, cool in your manner, and exercise an observing eye, and by these means you will certainly escape from nine out of ten of the beginner's troubles.

Whether a person shall succeed or fail in photography depends very much on the spirit with which he commences. If he think the whole process a *mechanical* one, mainly a question of apparatus, baths, and developers, he has no pleasant future. When he gets into difficulty—and he soon does—he declares his chemicals are wrong, his bath is out of order, his camera is bewitched, and rushes from shop to shop to buy the last “patent never-fail collodion,” or the marvellous Greek-named lens that takes pictures in a few seconds less than no time, or some other be-puffed and be-advertised nostrum, instead of stopping at home and quietly finding out in what his trouble consisted. Possibly he has mixed his plain collodion and iodizing solution in reversed proportions, or strengthened his nitrate bath out of the un-labelled hypo. bottle, or been trying to develop with his cyanide. Such a man soon wears himself out,

declares, "It's no use trying, it's all chance," and attributes the success of skilful men to the use of "secret dodges."

As a contrast, observe another man, who begins quietly and steadily, and, getting into trouble, thinks it probable that *he* is wrong, and not the chemicals; and, instead of throwing them down the sink, perseveringly proceeds, finally discovering that the same chemicals that formerly gave him bad pictures now furnish good ones, the difference being only *in the mode of using them*. A man of this stamp taking pride in his new acquisition, and not blind to his own deficiencies, reads the Journals, joins a Photographic Society, compares notes with his confreres, keenly enjoys a visit to a Photographic Exhibition, and speedily becomes an intelligent and clever manipulator.

DEFECTS COMMON TO GLASS POSITIVES AND NEGATIVES.

A darkening of the film all over, directly the developing solution is applied.—This defect, technically called "fogging," has several sources. It may exist in a small degree, only slightly obscuring the shadows of the picture, or so great as to prevent its appearance. Fogging often troubles the young beginner, and as it arises from many causes, it is often difficult to assign it to the right one. Sometimes deleterious vapours are the reason; as, the dark room being built over a stable and filled with reeking vapour; the room being newly painted with a slow-drying paint; a leakage of gas; a bottle of ammonia with a badly fitting cork or stopper. A remedy for any of the above is simply to remove the cause.

In extremely warm weather the developing solution is much more energetic, and fogging may thus arise; remedy, dilute it one half, or double the quantity of acid. The following are, however, the most usual causes of fogging:—

Alkalinity of nitrate bath; remedy, addition of acetic acid, till litmus paper is *slightly* reddened.

Extreme acidity of nitrate bath; remedy, addition of oxide of silver or ammonia, until litmus paper is only slightly reddened.

Omission of acetic acid in the developer; remedy obvious.

Over-exposure in the camera; remedy obvious.

Diffused light in the dark room. If yellow calico be used, it has perhaps become bleached, and must be replenished; or additional folds must be used. Sometimes chinks of unsuspected white light are the cause; if so, they must be stopped up.

Diffused light in the camera or the dark slide, admitted through a joint giving way, or an old screw hole, or the parts of the camera not fitting; remedy obvious.

Nitrate bath made with impure silver, or bad water; remedy, add a few drops of saturated solution of bicarbonate of soda, until the bath solution remains turbid after shaking, then expose it to the sun for a few hours and filter; acidify it if necessary.

Newly-mixed collodion, especially when developed with iron; remedy, add acid to the bath till it works clear.

When you make any change, such as having a new camera, a fresh bath solution, or another sample of collodion, you may be able at once to suspect and perhaps detect the cause. When you have no such clue, you must adopt a systematic method for its discovery. The following is the plan:—

First, examine your dark room, by covering your yellow window with some material that entirely excludes *all light*. Crevices and cracks admitting white light will then be seen, that before were unnoticed, and some of them may have

shone on the plate during its preparation and caused fog. If these are found, they must be stopped up, and your annoyance is over.

If these be not the cause, next suspect the window, for though it may admit only yellow light, it may not be yellow enough. Yellow materials become bleached, and require renewing, especially yellow calico. To test your window, and it is very important that you be quite certain on this point, proceed as follows: collodionize a plate as usual, and immerse it in the bath; then cover up your yellow window entirely, or leave only the smallest possible chink, so that you can just see what to do. Take your plate out of the bath and put it in the dark slide. Now remove the covering from the yellow window, and draw up the shutter of the dark slide *half-way*, to expose *one-half of the plate*: keep the plate to the light of the window for, say, five minutes, then replace the shutter, close up the window as before, and proceed to develop your plate. Keep the developing solution on about the usual time that is required to produce a picture, for you will not be able to see what is going on; then wash and fix it. Now restore the light and examine the plate, and it must present one of the three following appearances:—Case A, the half exposed to the window is drab, and the half not exposed is quite clear and transparent; case B, it has a drab deposit, in other words, fog, all over it; case C, the plate is perfectly clear and transparent all over.

We shall examine each of these. Case A shows that the yellow window is at fault, for the half of the glass exposed to it is fogged; but the other half is clear, therefore sufficient actinic light passes through to injure the plate. The yellow covering, if bleached, must be removed, or more coverings must be supplied, and a plate must be tried after each

addition, until you have your window so yellow that a plate may be exposed five minutes without being fogged. Yellow glass sometimes allows light enough to pass through to fog the plate; such glass should be removed, and a better sample put in its place. I have seen a piece of yellow-brownish glass, though very dark in colour, that admitted actinic light almost as freely as white glass. This is rare, but in photography you try all things, and only hold fast to that which is good. The window being covered with the proper material, your fogging will be over, and case A dismissed.

Case B, the plate darkens all over under the action of the developer, and you can distinguish no difference between the two halves; this shows that your window is quite right, and you must seek further for the cause. It must now lie between the bath, the collodion, and the developer. First, try the bath; test it with a strip of reddened litmus paper, and if it changes to blue the bath is alkaline, and an alkaline bath is a certain cause of fogging. Add acetic acid, drop by drop, testing between each addition, until blue litmus paper is *very* slightly reddened. Again try a plate, the fogging will probably not be quite gone, but much reduced; add a little more acid until it entirely disappears.

Suppose, however, that the reddened litmus paper did not change colour, then test with blue litmus, and if it turn *very* red, then carefully neutralize with oxide of silver, or ammonia, until only a slight acidity remains; then resume your trial to see if you have expelled your enemy, for excess of acid, especially nitric, will cause fog. Should the test-papers show that the bath is neither very acid or alkaline, the probability is that the error is in the developer or the collodion.

Make up, carefully, a fresh developing solution, being par-

ticular, if it be pyrogallic, not to omit the acetic acid. You may slightly increase the quantity of acid, for some samples are weak, and you may happen to have one; the developing solution, unless it have its proper addition of acid, will always cause fog. If the new developing solution rid you of your difficulty, well and good; if not, you must suspect your collodion. Some collodions cause fog, therefore get some fresh, and let it have a little colour, a pale golden for instance; for colourless collodions are more prone to fog than coloured ones. If you are not now relieved, you may assume that the nitrate bath is the defaulter, for it must be one of the three. Make up a new bath; and if you use good silver and clean water, you are almost certain to be out of your trouble.

Case C, the plate develops perfectly clean and transparent all over; this shows not only that the yellow window is all right, but that the chemicals are not the cause; in fact, that the origin of the fog must be external to the dark room; and as nothing else but diffused light can now be the cause, we must seek to discover it. First, examine the dark slide well, in some unsuspected manner it may admit light to the plate.

If your dark slide be found to be perfect, next examine your camera carefully. You may test it in this manner; prepare a sensitive plate as usual, and place it in the camera as if you were going to take a picture; put the cap on the lens, draw up *half way only* the shutter of the dark slide, but do not uncover the lens. Let the plate remain thus for a full minute, then develop and fix the plate. The plate will either be one-half fogged, or it will be quite clear all over. If half be fogged, it shows that the camera admits light in

some other manner than through the lens, and thus the fog is caused. To know where the light is admitted, remove the ground-glass; and, excluding all light with the focussing cloth, put your head into the camera, the lens being still covered, and you will see the light streaming in. You may examine the interior of your camera in another manner. Place the dark slide in its place, and draw up the shutter; remove the lens, and with the aid of the focussing cloth again examine the interior through the flange aperture. If any stray light be admitted, you will see it on the face of the plate. It is necessary, when thus examining the interior of a camera, to wait for a few minutes, to allow the eye to get accustomed to the darkness, or you may deceive yourself, and think there is no light, from your momentary inability to perceive it. The cracks, crevices, or holes, being stopped up, your trouble is past.

Should your plate, however, develop clear all over, it will show that the interior of the camera is perfect. Another cause of fog may arise from the lens itself. If a strong light fall on it, particularly sunshine, fog will certainly be produced. A screen or shade should be provided so that no light fall on the lens except from the objects that are being delineated. Occasionally there is reflection from the sides of the lens tube, or the edges of the back lens. Dead-black varnish will be the remedy in these cases.

If you have not now traced out the difficulty, having run through your chemicals and apparatus, it most probably is caused by an error of manipulation, such as over-exposure, or a deviation from the proper mode of development. It is scarcely probable, however, that you could pursue this inquiry without already having a clue to the real cause; and I have

gone through the series of exhaustive experiments to show you, that by this method of inquiry, you may succeed in tracing any trouble to its true source.

Transparent spots.—Causes : collodion not settled ; bath requires filtering ; dust in the camera ; knocking dark slide when plate is in ; bath not saturated with iodide of silver, or supersaturated with iodide of silver.

Opaque spots.—Causes ; developer not filtered ; dust falling on the plate while being coated ; dirt, and dried fragments of collodion from lip of collodion bottle ; dust and dirt from dark slide.

Streaky lines in the direction of the dip.—These are caused, in a new bath, by a deficiency of acid ; in an old one, by the accumulation of ether and alcohol. Remedy : in the first, add acid cautiously till the streaks disappear ; in the second, mix with it an equal bulk of plain thirty-five grain solution of nitrate of silver.

Sharp horizontal lines across the plate.—These are caused by hesitation in dipping the plate into the bath.

Collodion film mottled and thick.—The collodion requires diluting with a little plain ether.

The collodion film, on drying, peels off the glass ; it is full of honeycomb-like markings ; the film has transparent, crapy. diagonal lines, especially where the deposit is greatest.—These defects all arise from inferior collodion ; procure some of better quality.

Opaque white marks and streaks at the end of the plate where the collodion was poured off.—Keep the plate a longer time before you immerse it in the bath ; if this does not prevent the markings, add a little plain un-iodized collodion.

Transparent insensitive mark at the opposite end to where the collodion was poured off.—The plate was kept too long out of

the bath, and the upper part has become dry ; the plate must be immersed sooner into the bath.

Markings like curtains and fringes.—When these do not occur from bad manipulation—and be careful not too hastily to decide—these faults may arise from the collodion or the bath, and the best remedy is to endeavour to obtain samples that will work without thus plaguing you. When an iron developer is used, it is important that you have the proper quantity of alcohol in it, as this causes the solution to flow easily and smoothly all over the plate, and allows the developing solution readily to combine with the silver solution which is on the film. When the developer flows in irregular greasy lines, there are sure to be abundance of stains from this cause alone.

DEFECTS IN GLASS POSITIVES.

The light parts are pale and misty, and what should be the dark parts are drab-coloured.—Over-exposure produces this effect ; reduce the time in the camera, or place a smaller diaphragm in the lens to cause it to work slower. If this treatment does not remove the mistiness, it may be produced by “ fog,” a remedy for which see page 35.

The blacks are very deep and brilliant, but deficient of detail, and the lights rather dark.—The exposure in camera is not sufficient, or the developing solution was poured off too soon.

The picture, after washing off the cyanide solution, has blue stains.—The developing solution has not been sufficiently washed away before the fixing solution was used.

The shadows of the picture are clear, but the light parts are chalky, and deficient in half tone.—The developing solution has been kept on too long.

*The picture is brilliant when wet, but on drying becomes dull, the shadows being misty blue instead of bright black.—*Bad collodion is the cause of this defect.

DEFECTS IN NEGATIVES.

*The picture very intense where the light has acted most, and nearly transparent in the shadows.—*The plate is under-exposed and over-developed.

*The shadows have nearly as dense a deposit as the high lights.—*The plate is over-exposed.

*The image will not intensify under the action of the pyrogallic acid and silver solution.—*There are many causes for this defect, and you must discriminate which is the most probable in your own case, and act accordingly. Bad collodion—inferior nitrate of silver—too much acid, especially nitric, in your nitrate bath—the exposure, too long or too short in the camera—the absence of sufficient nitrate of silver solution on the film or in the developing solution—cold and dark weather—deficiency of light—too small a stop used with long focus single lens.

*The film floats off, or breaks away from the glass, during development, or subsequent washing.—*Defect in the collodion, or carelessness in manipulation. Plate immersed in bath too soon, or kept out too long. The edges of glass not sufficiently roughened.

*The formation of crystals under the film when dry.—*The hyposulphite solution not washed away enough. Sometimes this will show immediately; at other times it may be days or weeks before being seen.

*Irregular smears and stains.—*Dirty glasses is the most usual cause, also lifting the plate out of the nitrate bath too soon; placing it in the dark slide before the greasy lines

have disappeared ; not draining sufficiently, and the solution accumulating at the bottom ; from dirty and wet plate holders in the dark slide ; handling the plate with dirty hands ; the developing solution not flowing uniformly ; pouring the developer principally on one spot ; plate immersed in bath too soon, or not soon enough ; developing glass not clean.

DEFECTS IN PAPER PRINTS.

The paper does not print equally all over ; has marbled or mottled spots.—The silver solution is too weak. If the *silver-meter* be used, and the strength kept up to at least 60 grains, this defect will never occur.

The print when finished has a disagreeable yellow tint, and on looking through yellowish-brown opaque patches are seen.—The print is not fixed ; the hyposulphite is too weak, or has been in use too long, or the print has not been immersed long enough to dissolve the chloride of silver.

The whites and blacks are very brilliant, but a deficiency of detail in both.—The negative is at fault, under-exposed.

The prints are weak, cold, and slaty.—Under-printing and over-toning are the general causes. Over-exposed negatives produce weak prints deficient in proper contrast.

The prints are grey and mealy.—Over-toning and defective paper.

Red spots, streaks, and markings.*—Defects in the paper, or the albumenizing, or both.

Prints will not readily tone, but remain of a brown, leathery hue.—Toning bath too alkaline ; chloride of gold deficient in strength ; the toning bath exhausted ; the paper kept too long before being printed on, or, after being printed, kept too long before toning.

Metallic smears, spots, stains, finger marks, &c.— These defects nearly always arise from bad manipulation, handling the paper with dirty fingers; allowing solutions to splash; putting the paper on a dirty table; dust and dirt in the printing-frame, or on the pads used in the latter, or similar causes; or they may occur from bad paper.

THE proposed course of instruction in the usual collodion process is now completed, and practice is only required to make you entirely perfect.

Part II. is devoted particularly to the preparation of sensitive dry plates. These, however, you should not attempt until quite competent in the use of wet ones.

Part III. contains much which will be more useful to you as you acquire experience, and is more addressed to the expert photographer than the mere learner.

From the progress you may be presumed to have made, the homely and familiar style in which the instruction has been hitherto conveyed will now cease, and the remainder of the information will be given in a more condensed form.

Your attention is invited, however, to the following hints and general advice, by the attention to which, you will save much valuable time and materials, and render the practice of the art more interesting and profitable.

HINTS AND GENERAL ADVICE.

CONCENTRATE your attention on the production of a good clean negative; a professional printer may be employed to produce your prints.

Never expect the faults of the negative to be corrected in

the printing, a good print can never be produced from a bad negative.

Take a pride in cleaning the glasses well; stains and smears always indicate slovenliness and inattention.

Whenever you take a negative, take as good a one as you possibly can, even though it be a bad subject; almost anything looks well in a first-rate photograph; moreover it is excellent practice.

Never be contented with a medium picture if you can obtain a better one; "I dare say it will do" will never do at all in good photography.

Obtain the most perfect apparatus that your means afford, and take a pride in keeping them clean and in good order.

Wipe your lenses before using with a soft chamois leather, and dust out the interior of your camera with a damp cloth.

Wipe your dark slide dry after each plate; the accumulation of nitrate of silver at the bottom corners of the dark slide stains the plate, rots the wood, and denotes the careless operator.

Carry your dark slide in a cloth when taking it from place to place, especially out of doors, and cover the top of the slide with it while the plate is being exposed.

Keep your camera exactly level when perpendicular objects are to be represented.

Get all parts of the picture into focus if you can, if not, make the principal objects the sharpest—in a portrait, the eye; in a group, the central figures; in a landscape, the foreground, in preference to distant objects.

Keep your nitrate bath always covered, and your bottles well corked or stoppered, as well as distinctly labelled.

Wash your hands after taking one picture before commencing another.

Wash your developing glass after each time of using.

Keep a separate vessel for every solution, and a separate bottle and funnel for each distinct purpose. Much time and trouble in cleaning dishes and bottles will be saved, and no end of uncertainty removed.

Never open a bottle of collodion, ether, alcohol, or varnish near a flame, or an explosion may take place.

Never allow the sun to shine on the lens when taking a picture.

Never attempt landscapes on windy or misty days.

Of the two errors, under-exposure is worse than over-exposure.

Aim at *good* pictures rather than quick ones.

There is more certainty in working a slow than a quick process.

Learn one process thoroughly so as to be able to depend on it; then, and not till then, amuse and instruct yourself by practising others.

Don't be led away by every fresh idea you hear; don't expect to succeed with every new process you read of, but don't condemn it because it fails in your hands.

Don't believe every novelty to be an improvement; don't hastily credit every "new discovery;" make great allowance for the exaggeration and enthusiasm of inventors, but keep your mind open and unprejudiced, to receive every new truth from whatever quarter it may proceed, or in whatever guise it may appear.

PART II.

DRY COLLODION PROCESSES.

THE wet collodion process has the drawback that, as all the operations are done on the instant, a considerable quantity of apparatus and chemicals are required near where the picture is taken. To obviate this, many methods have been devised to use the plate in a dry state, and the most successful of these will be detailed. Opinion is still divided as to their relative merits, each person naturally declaring that one to be the best with which he most succeeds. It is certain that some processes seem better fitted to the idiosyncracies of individuals than others. Each person should, therefore, not jump from one to the other, but select a method which he feels is in harmony with his feelings and mode of working, and by carefully studying its details, he will obtain a mastery over it, and its practice will be a source of pleasure.

Essentially all the processes are the same; they all start by coating a plate with collodion, and sensitizing it in a nitrate of silver bath; their differences consist in the various methods employed to preserve the sensitiveness that the plate has attained. In most, if not in all, this sensitiveness is materially impaired, but as the subject becomes better understood, it will probably be found that the plate in its dried state is as susceptible to the influence of light as when wet.

Hitherto a sensitive dry plate has been treated as a wet plate *minus the water*, and by restoring the water the plate

has been expected to return to the condition of an ordinary wet plate. Experience, however, has not quite confirmed this reasonable supposition. A re-wetted sensitive plate even when re-immersed in the nitrate bath, does not return to the condition of an undried plate, and the mode of development, so exactly adapted to the wet plate, is not so well suited to the dry one when re-wetted. The conditions have changed, and the mode of development must alter too. Already the greatest advance in dry-plate photography has been, not in the preparing, but in developing the plate. Let the idea be once recognized, that the dry plate is not bound necessarily by the conditions of the wet, and the path of discovery is opened. Great success has already been obtained by working in this direction, and that future advances will be made is extremely probable.

GENERAL REMARKS ON THE VARIOUS DRY PROCESSES.

In working any of the dry processes the operator is called upon to exercise much judgment, and for this reason inexperienced persons should not attempt the dry plates before thoroughly understanding the wet ones. In addition to all the difficulties of the usual wet process are added those of the particular dry method adopted. Though the various processes are different, some as complex as others are simple, yet a few remarks may be made which are equally applicable to them all.

The collodion film, as already remarked, when once dried, changes its character and when re-wetted never returns to the previous porous, pappy condition. It becomes skinny and horny and does not adhere well to the glass. In some processes a thin coating of an adhesive substance as albumen,

gelatine or india rubber is first put upon the plate to prevent the film slipping off when re-wetted and during development. If it were not for the trouble, some precaution of this kind might be adopted in every case, and the operator should remember that whatever process be practised, the perfect adhesion of the collodion to the plate can be secured by using first a coating of gelatine, 3 grains to the ounce of water, or of albumen, white of one egg to 10 ounces of water, or of the thinnest film of india rubber dissolved in chloroform, benzole or turpentine.

Another method is to varnish the plate about a quarter of an inch all round before coating it with collodion.

Another plan is to varnish the film a quarter of an inch all round before re-wetting the plate.

An excellent suggestion by Mr. Bartholomew, is to pour common alcohol over the plate, prior to developing; this seems to restore to some extent the porous condition. When the alcohol has well soaked in, the plate is to be washed, and the developer applied as usual; all the subsequent operations will be made better through this preliminary wash of alcohol, the plate behaving more like an ordinary wet one, and the film adhering well to the glass. The method is applicable to all processes but is most useful to the simply washed plates and the tannin plates.

The nature of the collodion is of vital consequence in some processes, and of less moment in others. In those where albumen forms an integral part it is not so important, but in the simple dried plate and with all varieties of the tannin plates, success is largely dependent on the collodion.

It will be seen, in glancing over the different processes detailed, that though the final end, a sensitive dry plate, is the thing aimed at in all, the means adopted to secure it are

very varied. In nearly every case a something is incorporated with the sensitive film which is not present, or even needed when the plate is used wet. The employment of the simply washed and then dried plate, is, though the easiest, perhaps the least certain of all; yet persons do use the process with success. Nearly all experimenters find that by adding a final wash of some substance, the image develops and intensifies more like a wet plate than without this addition. The number of these preservative substances is endless, and the mode of employment constitutes the different dry processes. No end of aqueous solutions of animal and vegetable substances have been used with different degrees of success. Albumen is deservedly a great favourite. Gelatine has been applied in more than one form, and sugar in many; to wit, honey, treacle, grape sugar, brown and white sugar, candy, and caramel. Many syrups, especially raspberry; different gums; solution of malt, beer, and ale; various wines, British and foreign; liquors and spirits; milk, tea, coffee, starch, dextrine, and kindred substances, in fact there scarcely seems a limit to materials capable of being used for the purpose, so that the question is quickly obtruded, which is the best? To this there is no definite answer, for good pictures have been taken by every process. For absolute certainty the Collodio-albumen in its primitive form is recommended; for simplicity the Resin or Morphine Process, while Major Russell's Tannin, and Dr. Ryley's modified Fothergill Processes, are both of them easy and certain, requiring little else than a knowledge of the wet process. The idea, however, to be strictly borne in mind, is that the preparation of the sensitive collodion plate is the main thing, and all the preservative solutions but play a secondary and comparatively unimportant part, and are useful so far, and no farther, than they aid in maintaining the original sensitiveness of the plate.

The collodion most suitable for all the processes is the bromo-iodized. It should be of the powdery or non-contractile kind, and such that attaches itself tenaciously to the glass. In all instances the glasses require more careful cleaning than in the wet process, and if they be roughened about a quarter of an inch all round it will be better than being plain, as the collodion attaches itself more firmly to roughened surfaces, and is less subject to detach itself when re-wetted.

THE SIMPLY "WASHED-PLATE" PROCESS.

This is the simplest process of all, and consists of preparing and sensitizing the plate as for the wet method, then washing it well in distilled water to get rid of all the superficial nitrate of silver solution. The plate is then to be carefully dried in the dark. The exposure should not be much more, some say the same time, as for a wet plate. Prior to development, the plate must be re-immersed in the nitrate bath, and the development conducted just the same as for a wet plate, the ordinary pyrogallie acid or iron solutions being used. These plates will not keep. They should be prepared over night, and used the next day, and developed in as few hours as possible after exposure.

With favourable samples of collodion, this process yields good pictures.

ANOTHER SIMPLE DRY-PLATE PROCESS.

Prepare the plate as in the preceding method, but after washing the plate from the nitrate bath, immerse it for a few minutes in a dish containing a solution of chloride of ammonium, two grains per ounce, and wash well again; finally immerse in the following bath:—

Gallic acid	...	...	2 grains.
Alcohol	...	...	10 minims.
Water	...	...	1 ounce.

A dish or a dipping bath will be convenient for this solution. Let the plate dry from this gallic acid bath without any washing. These plates give clear and brilliant negatives, and are very sensitive, but they cannot be depended on for keeping. The process is considered more certain than the former one. As these plates have a coating of gallic acid, they must not be immersed in the nitrate bath; but to develop, moisten them first with weak alcohol, and then with distilled water, and immerse them in a dish containing saturated solution of gallic acid, to which is added a few drops of a 30-grain nitrate of silver solution. A more rapid developer is formed of

Pyrogallie acid	...	...	3 grains.
Citric acid	...	...	$\frac{1}{2}$ grain.
Distilled water	...	...	1 ounce.
Alcohol	...	...	$\frac{1}{2}$ drachm.

Moisten the surface of the plate as before, and then with the above developer, and when it has well soaked in the plate, pour the solution off, and add a few drops of the 30-grain nitrate of silver solution, pour on again, and the image will quickly appear. The rest of the development is as usual. Dry plates usually take much longer to develop than wet ones, and should never be made so dense as in the usual wet process, as they become more intense on drying.

RESIN PROCESS.

The peculiarity of this consists in adding common resin to

a bromo-iodized collodion in the proportion of half a grain to the ounce. It is readily dissolved. The plate is then sensitized as usual, well washed and dried. Expose about the same time as for a wet plate. Immerse in the nitrate bath before developing, and employ the usual pyrogallie or iron solutions. The development is very similar to the wet plate. These plates are said to retain their sensitiveness for a few weeks.

MORPHINE PROCESS.

This is a very simple process, and considerable testimony has been given in its favour as to its capacity for producing a clean and rapid dry plate. Its introduction is due to that indefatigable and intelligent experimenter, Mr. WILLIAM BARTHOLOMEW. His directions are:—Add one grain of muriate of morphia to eight ounces of the usual nitrate of silver bath. (Dissolve the muriate in a small quantity of distilled water before adding it to the bath.) Filter from the precipitate which is formed. The bath should be slightly acid with acetic acid. Employ the usual bromo-iodized collodion, sensitize the plate as usual, wash in a dish in distilled or rain water, until the greasiness of the surface is removed, and let the plate dry. Expose in the camera the same time, or half as long again, as for a wet plate. After exposure, wet the plate well with distilled water, immerse it in the nitrate bath for a few seconds, drain it, and develop with the usual iron or pyrogallie acid solutions.

This process may be considered a variation of the simply washed plate, or, as intermediate between that and the application of a preservative; for the organic matter is in the film, and introduced during sensitizing, and not applied on the film after sensitizing. Success with this process will

considerably depend on the sample of collodion and the degree of washing.

The nitrate bath is not supposed to be injured for the usual wet process by the addition of the morphine. Mr. Bartholomew says he has kept his bath in use for months, and that he uses it equally well for both purposes.

GELATINE PROCESS.

This is one of the earliest dry processes. It originated with Dr. HILL NORRIS, of Birmingham. Somehow, though it has been clearly described and excellent pictures obtained by it, it has never been popular, though plates prepared by it have for many years been articles of commerce. This fact is a strong recommendation of their keeping qualities. The following description by Dr. Norris will give a clear idea of the manipulation:—Coat the plate with a porous collodion, and excite in a neutral 30-grain bath in the usual manner. Drain the plate, and to wash the free nitrate of silver away, provide three flat dishes of porcelain, filled with distilled water, and immerse the plate in the first dish. Prepare a second plate in the nitrate bath, and when ready, transfer the former plate to the second dish, and so on with another plate till the first one reaches the third dish. The first water must not be used more than three times, when the dish must be emptied and take the place of the last dish. When the plate is removed from the first dish it should be slightly washed, back and face, with distilled water, so that as little as possible of nitrate of silver may be conveyed into the second water. While the plates are soaking, a rocking motion should occasionally be given to the dishes. The plate having remained about five minutes in the third dish, it may be taken out, and then, after the surface being swilled, it is ready to be coated with the following preparations:—

Nelson's patent gelatine	...	80 grains
Distilled water	... ..	20 ounces.

Dissolve the gelatine by heating the water to the boiling point, and filter while hot through two filter papers. It should then be carefully boiled down to half the quantity. When cool, add $1\frac{1}{2}$ ounces of alcohol and bottle for use. To employ this, stand the bottle in a saucepan of boiling water; pour on one end of the drained plate sufficient of the hot gelatine solution to cover the surface. The liquid is heated not merely to dissolve it but to make it penetrate the pores of the plate, and the plate being heated dries more readily and evenly. The gelatine having floated backwards and forwards for a minute or so, is poured off at the opposite end it was poured on into the waste pan; reverse the plate and repeat the operation, reserving this solution for the first on the next plate. The plates may then be dried spontaneously or by artificial heat. If they are prepared at night, they may readily be dried within two feet of a brisk fire. When dry, they will keep indefinitely if properly packed.

Expose with a stereo lens, 6 inch focus, $\frac{1}{4}$ inch stop, from one to two minutes in sunlight; some objects will require longer. Develop by immersing the plate in a dish of distilled water, drain for a few seconds, and pour over,

Pyrogallie acid	... ..	3 grains.
Glacial acetic acid	... ..	1 drachm.
Distilled water	... ..	1 ounce,

to which has been added about a drachm of a 20-grain nitrate of silver solution. When the solution turns muddy, change it for a fresh dose. Stereoscopic plates require about a quarter of an ounce of this developing solution. Keep it in motion over the plate, and when the image is fully out and sufficiently intense, wash and fix it as a wet plate. If time is not an

object, these plates may be developed very perfectly with a saturated solution of gallic acid, to which has been added a few drops of a 20-grain nitrate of silver solution. About an hour or more may be required for each plate, but many plates may be developing at the same time.

If gallic acid be used as the developer, care must be taken not to intensify too strongly, as the greenish-brown colour produced is very non-actinic, and a dense deposit is not required.

The fixing is best done by hypo, and the plate will require varnishing as usual.

MALT PROCESS.

This process differs from the preceding mainly in the employment of a different solution to give the final coating. It was introduced by Mr. JOHN MACNAIR, and is a great favourite with many persons for the soft and delicate, yet quick, pictures it yields. The process is thus detailed by Mr. Macnair:—

“For making the infusion of malt, I use a common earthenware teapot, which holds about a quart and a half, and which, before being used, is well warmed with hot water.

“Mix 7 ozs. of well-bruised or ground pale malt in about 24 ozs. of hot water, so that the mixture, after being well stirred, will be at the temperature of, from 155° to 158° ; if the heat be higher or lower, cool or raise it rapidly to 155° to 158° . Place the teapot containing the infusion before a moderate fire for about half an hour, when the heat will have fallen to about 138° , and the infusion has acquired a sweetish, but not luscious taste. It may then be removed a little further from the fire to cool slowly for two or three hours, and frequently well stirred during that time, and then

filtered, when it should be quite fluid, bright, and of the colour of very pale sherry. For larger or smaller quantities use the same proportions of malt and water.

“Roughen the glass plates well at the edges on a flat stone—not with a file,—and use a fluid collodion that will adhere well, pouring it on carefully to the edges of the plate; excite in a neutral bath of 35 grains nitrate of silver per ounce of water; wash off all the free nitrate of silver at a tap, or with a jug, finishing with distilled water. The free nitrate will have been got rid of when the greasy appearance which the plate has when the water is first applied is entirely removed; the plate will then be sufficiently washed. Rest the plate for a few seconds on blotting-paper, and before it begins to dry, pour over the malt infusion in the same way as the collodion; wipe the back of the plate, and then dry (the quicker the better) either before a dull fire without flame, or better, and to avoid dust, place the plates in a box before the fire, ranging them in a slanting position, with the end from which the collodion and preservative coating were poured uppermost, and the coated side inwards. A hot-water foot-pan, or a couple of hot fire-bricks placed on a slate in the box, will greatly accelerate the drying of the plates.

“The time of exposure for taking views may be reckoned the same as with wet collodion; and for copying from a negative by contact, from one to three seconds will suffice.

“After exposure, wash off the preservative coating, letting the water flow from the centre of the plate towards the edges; then, using a plate-holder, dip the face of the plate in a solution of nitrate of silver, or in the bath; but for this purpose it is better to have a separate bath, and one of 20 to 25 grains nitrate of silver per ounce is strong enough. Develop with—

Protosulphate of iron	...	...	20 to 30	grains.
Glacial acetic acid	...	...	$\frac{1}{2}$	drachm.
Alcohol...	...	...	$\frac{1}{2}$	drachm.
Water	...	...	1	ounce.

"If more intensity is wanted, wash, and continue the development with

Pyrogallie acid...	...	...	2	grains.
Glacial acetic acid	...	...	$\frac{1}{2}$	drachm.
Alcohol	...	...	$\frac{1}{2}$	drachm.
Water	...	...	1	ounce,

adding a few drops from the nitrate of silver bath.

"After fixing, bichloride of mercury, followed by ammonia, hyposulphite of soda, or any of the other agents, may be used to alter the tone, or give more density.

"An equally certain preservative may be made by infusing coarse Turkish barley, or rye, or Indian corn meal, adding about an eighth part of ground malt; either of these will make a firmer coating than the malt solution, but which requires a little more careful washing off. The infusion of barley should be made at a temperature of about 145° , and the Indian corn about 150° ."

In speaking of the above, a very talented operator, the late Mr. Orange, said, "For the last twelve months he had practised the process professionally very extensively. The other day he had prepared 300 plates, with which he could be certain of getting ten good negatives out of every twelve plates. The process is, therefore, as certain as any yet known, and gives results equal to wet collodion. The advantages are—the ease with which the plates are prepared, their remarkable sensitiveness and rapidity of development, and the unusual power of their withstanding the wear and tear of printing."

TANNIN PROCESS.

This excellent process is especially commended to photographers for its certainty and simplicity. Its inventor, Major RUSSELL, deserves the thanks of the photographic public for the patience and perseverance with which he has worked out and improved it; and for the kind and frank manner in which he has communicated the information.

The plate is to be coated with a bromo-iodized collodion, and excited in an ordinary negative nitrate of silver bath, thirty-five grains to the ounce, faintly acid; then drain and wash it well under the tap, and allow it to lie in a dish of water, while another plate is being sensitized in the bath; next pour over sufficient solution of Tannin, two grains to the ounce to well cover it. Allow it to flow backwards and forwards to well permeate the film; then pour a second portion over in like manner, drain the plate on clean blotting paper, and finally wash the Tannin solution off thoroughly, finishing with distilled or rain water.

The exposure required will be about four times longer than for wet collodion. To develop, first moisten the plate with weak alcohol, wash well, and pour on solution of pyrogallie acid, three grains to the ounce, to which is added at the time of using an equal bulk of a solution composed of nitrate of silver, four grains; citric acid, six grains; water, one ounce.

The development is almost as quick as wet collodion. This process is excellent for producing rich-toned transparencies.

These plates will retain their sensibility unimpaired for a considerable time.

IMPROVED METHOD OF DEVELOPING TANNIN PLATES.

By the method already stated, excellent pictures may be obtained, but where a much shorter exposure is given, Major Russell recommends another mode of development.

Make up the following solutions :—

No. 1.

Carbonate of ammonia	...	...	12 grains.
Alcohol .830	...	...	3 ounces.
Distilled water	...	...	5 „

No. 2.

Pyrogallic acid	...	...	32 grains.
Alcohol .830	...	...	3 ounces.
Distilled water	...	...	5 „

Measure out as much of No. 1 as will cover the plate—two drachms is enough for a stereoscopic size—and pour it on : let it soak in, then turn it into the developing glass, and add of No. 2 one quarter the quantity of No. 1 ; mix, and put back on to the plate. Pour off and on as in developing a wet plate, and then let it remain at rest. The image starts out quickly ; when all the details are developed, the plate may be thoroughly washed, and the image made intense by continuing the development with the developer given for the tannin process.*

TANNIN AND HONEY PROCESS.

This modification of Major Russell's process is made by Mr. England, who finds the addition of a proportion of honey

* The reader is referred for further particulars of this valuable dry process to Major Russell's work on the Tannin Process, Second Edition.

makes the tannin much quicker. The formula is as follows :—
 Use a bromo-iodized collodion, in which there are equal proportions of a bromide and an iodide. Sensitize in a 40-grain neutral bath, wash in a bath of distilled water slightly acid with acetic acid; next wash well under the tap, and coat the plate with a solution, 5 grains tannin, 5 grains honey, water 1 ounce. Dry the plate well, and it will keep six months. Let the exposure in the camera be twice or three times as long as for wet plates. To develop, make a bath of—

Nitrate of silver	...	...	...	10 grains.
Acetic acid	...	...	...	5 minims.
Water	...	...	...	1 ounce.

Immerse the plate for about a minute, and develop with

Pyrogallie acid	...	...	...	3 grains.
Acetic acid	...	...	...	30 minims.
Water	...	...	...	1 ounce.

The plates develop very quickly. No nitrate of silver solution need be added to the pyrogallie.

When a short exposure is given, instead of developing as above, adopt Major Russell's modified development (page 61), which is equally well adapted for this process also.

The honey and tannin solution, instead of being allowed to dry on the plate may be washed off, which will render the plate rather more sensitive.

MR. SUTTON'S RAPID DRY PROCESS.

This process Mr. SUTTON considers to be the most sensitive of any extant, equal to the wet plate. He attributes the sensibility to the use of a proper collodion in which the iodide and bromide are in equivalent proportions, and to

the use of the special preservative solution. His words are, "Strange to say it only differs from the tannin process in the nature of the preservative used, and all the operations are the same in both.

"The preservative of gum arabic is made by dissolving 25 grains of the gum in one ounce of cold water, and using it at once. Stale gum will not do. You have only to apply this solution of gum instead of tannin to the plate, and all the other operations remain the same.

"It is absolutely necessary, in order to ensure rapidity of action, that the collodion be made in the manner described for bromo-iodized collodion, that is, that the collodion should contain an equal number of atoms of iodine and bromine. The nitrate bath may be acidified with acetic instead of nitric acid, or it may be used neutral, but acetic acid gives the clearest negatives, though not the highest degree of sensitiveness.

"When the plates are to be used very soon after their preparation, a few drops of a solution of gallic acid may be added to the gum, and more sensitiveness obtained, but there is some risk of failure, and the plate will not keep so well.

"Give the same exposure as for a wet plate. Develop by first wetting the plate with distilled water, and pouring on the following developer:—

Pyrogallic acid	...	...	...	2 grains.
Glacial acetic acid	...	...	...	40 grains.
Distilled water	...	...	...	1 ounce.

Add at the time of using a few drops of a weak solution of nitrate of silver. The image quickly appears, and very soon acquires the necessary intensity.

"Fix the negative in the usual way with a saturated solution

of hypo, soda or lime, and when dry varnish it with spirit varnish.

"Negatives taken in this way are equal in every respect to those taken on wet collodion plates, and the process is as simple as any of those for slow dry plates."

Mr. Sutton further says that these plates "preserve their sensitiveness and good qualities for several weeks, and perhaps indefinitely."

MR. KEENE'S RAPID DRY PROCESS.

In introducing this process Mr. KEENE is desirous to explain that the novelty consists, not in the materials, but the mode of using them. The method is the result of a series of very interesting experiments with various preservative substances, the object in view being to discover the most sensitive, and to test how far it is advisable to wash the free nitrate from the plate when it comes from the bath, before coating it with the preservative.

Mr. Keene became convinced from his experiments that the most sensitive plate was produced when he did not wash it at all, but applied the preservative at once to the plate as it came from the bath. The particulars of the process are:—Bromo-iodized collodion containing equal portions of an iodide and bromide; a nearly neutral 35-grain bath; developer, two grains pyrogallie acid, citric one grain, glacial acetic acid ten minims, and a few drops of a 15-grain silver solution to each drachm at the time of using. The preservative solution is made with equal parts of tannin solution, 15 grains to the ounce, and gum mucilage, the latter formed of four ounces picked gum arabic in eight ounces of distilled or rain water.

Sensitize in the usual manner, except that the plate must

remain in the bath at least half as long again as with ordinary collodion, bromide of silver being formed more slowly than iodide; drain for a second or two, apply the preservative solution pretty liberally, commencing at one corner, allowing it to flow to the other, next the third, and off at the fourth with the surplus bath; drain closely. Apply a second or even third quantity, passing it several times round the plate. This second quantity may be used for the first time to the next plate, but must not be returned to the stock. Drain again, and pour over the plate a little distilled water; work it about the plate so as to facilitate the even and complete removal of the preservative in the subsequent washing. Next, completely wash away all the preservative in a series of dishes, or under the tap, or other convenient way; drain and dry the plate, frequently changing the blotting-paper upon which it should rest while drying.

Expose about the same, or a trifle longer than for a wet plate. Soak a few minutes in soft or distilled water before developing; develop in the usual manner. Fix with hypo or cyanide. Mr. Keene had not satisfied himself as to the keeping qualities of the plates; neither had he tried any of the unusual methods of development.

This process closely resembles Mr. Sutton's gum process, and Mr. England's tannin and honey, except in the important modification of adding the preservative direct to the nitrate of silver solution, instead of washing it away. To this is attributed in part the supposed superior sensitiveness of the process.

COLLODIO-ALBUMEN PROCESS.

This process, introduced by Dr. TAUPENOT, hence often alluded to by his name, is, in reality, a double one. It

bears the reputation of being the most certain of all. By its means Mr. Mudd, of Manchester, and others, have produced some of the most lovely photographs ever taken. To those persons who don't mind work, and who are desirous always to succeed, this process offers particular attractions. The collodion and the albumen seem to unite and support each other, and, unitedly, to do something better than they often effect separately. The process is usually described as "slow, but sure;" of its sureness, many of its most successful practitioners have very confirmed opinions, and, as to its slowness, that really seems a matter of development. With the aid of heat, and the absence of acid (or even with the presence of alkali) in the developer, it is probable that by this process as rapid pictures may be taken as by any other.

Pour the collodion on as usual, and let it set well before immersing in the nitrate bath. A pneumatic holder should be used, so that the plate may be covered to all the corners.

NITRATE OF SILVER BATH.

Re-crystallized nitrate of silver	...	1 ounce.
Distilled or boiled rain-water	...	12 ounces.
Glacial acetic acid	... ..	$\frac{1}{2}$ ounce.
Iodide of potassium	... ..	2 grains.

Dissolve, filter, and the bath is ready for use. It will become discoloured, but this may be disregarded until almost port wine colour, when a few drops of solution of common salt, strength not important, may be added, and this, with agitation and subsequent filtration, will clear the solution.

When the plate is sensitized, wash it well with common water, and place it in a dish half filled with solution of iodide of potassium, one grain to the ounce, and allow it to remain

on while the plate is being prepared. Next remove it from this solution, and wash it well with clean water, and pour over its surface the following solution of iodized albumen.

IODIZED ALBUMEN SOLUTION.

Distilled water	...	...	...	...	3 ounces.
White of eggs	...	...	...	...	10 „
Iodide of ammonium	...	...	...	...	50 grains.
Bromide of ammonium	...	...	...	...	10 „
Chloride of ammonium	...	...	...	...	2 „
Liquor ammonia (fortis)	...	...	...	...	100 minims.

Place these materials, together with some pieces of broken glass, in a bottle capable of holding twice the quantity, and agitate till the whole forms a froth, and then, when settled, it is ready. This solution will keep a considerable time, but must be filtered before using.

Allow the solution to flow backwards and forwards to well saturate the film, repeat this operation with a second portion, and then set the plate aside to drain on blotting paper. When the moisture is principally removed, finish the drying before a fire, or by other convenient means.

The plate in this condition is nearly insensitive to light, and provided it be kept dry, will remain good for any time.

To render it sensitive, heat it as hot as the hand will bear, and, when cool, immerse it again in the nitrate of silver bath for one minute, *using only a yellow light*, then wash thoroughly in clean water, and dry in the dark.

These sensitive plates will keep good for a few weeks in warm weather, or even months in cold, if the last washing has been perfect; yet it is better to use them as soon as convenient after their second sensitizing. They will require about six times as long exposure as ordinary wet collodion,

but a little over or under is not very important; an error on the former side being better than the latter, the special point being to expose sufficiently long to bring out all the detail in the deepest shadows.

Gallic acid or pyrogallic may be used as developers. If the former, put the plate in a dish, and pour sufficient saturated solution of gallic acid over, and when the film has been wetted, add a few drops of a 30-grain nitrate of silver solution. The image will begin to make its appearance in a few minutes. This developing solution does not act quickly, but it produces the best results. From half an hour to an hour is the usual time required, sometimes much longer, if the plate has been under-exposed. Several plates may, however, be developing at the same time. They may be taken out and examined occasionally. If a sediment form on the surface, wash the plate, and while under the water use a little friction to remove it, employing a large camel-hair brush, cotton wool, or even the finger. Then return the plate to the developing solution, and continue the action. It is surprising how hard the film is, and what an amount of rough usage these prepared plates will bear compared with the usual collodion films. The development must be continued till all the details are entirely out, and the requisite density produced. It must be remembered that the deposit produced on these plates has a greater power of obstructing light than in the usual process; the same amount of density therefore is not required, or the finished picture will be too hard and chalky.

Pyrogallic acid solution (see page 22), to which a few drops of nitrate of silver solution have been added, may also be employed for developing, the precaution being taken of well wetting the film first with clean water; it acts much

quicker than gallic acid, and therefore requires more careful watching.

Saturated solution of hypo soda must be used for fixing these plates, not cyanide of potassium.

The above process is very certain, and, with moderate skill, the most beautiful results may be obtained.

ALBUMENO-COLLODION PROCESS.

This may properly be termed an inversion of the collodio-albumen process, the collodion resting on the iodized albumen instead of the reverse. One sensitizing is only required; it is supposed to combine the certainty of the collodio-albumen with fewer manipulations, as only one sensitizing and one washing are necessary. It was proposed by Mr. ALFRED NELSON, but does not seem to have been much practised.

Coat the cleaned plate with the following preparation:—

Albumen	...	...	...	8 ounces.
Distilled water	...	...	...	2 „
Bromide of ammonia	...	...	...	16 grains.
Chloride of ammonia	...	...	...	1 grain.
Ammonia	...	...	...	20 minims.

Beat up to a froth, let it settle for a night, filter through sponge into a stock bottle, and put a bit of camphor in to prevent mouldiness. Coat the plates with this preparation as with collodion; breathing well on the glasses causes the albumen to flow better. Drain the albumen off into a separate bottle, so that when re-filtered it can be used again. Stand the plate face to the wall, one corner only touching; the bottom corner resting on two folds of blotting paper. Avoid all dust and floating particles when albumenizing the plates; remove with a camel-hair brush all dust from the

plate before pouring on the preparation. The plates do not require the usual careful cleaning, and the time occupied in coating may be saved in the cleaning. When the plates are dry they may be stored away as clean plates ready for collodionizing. Coat the albumened plate with good bromo-iodized collodion; let it set rather more than for wet plates; sensitize in a 35-grain bath, one minim of glacial acid to each ounce of solution. When taken out of the bath, put it in a dish of distilled water till a second plate is ready, then wash it thoroughly, finishing with distilled water. Dry the plate well, and, Mr. Nelson says, expose about one-half longer than for wet plates; but the exposure will probably be much longer. Inventors have a weakness for over-estimating the sensitiveness of their plates.

To develop, wet the plate well with dilute alcohol, wash the spirit off with distilled water, pour on the pyrogallie acid developer (see page 22), to which a very few drops of a 30-grain silver solution has been added. The remainder of the operations are as in the other processes.

FOTHERGILL PROCESS.

This process, introduced by Mr. FOTHERGILL, may be considered as an abbreviation of the collodio-albumen process. It has been largely practised by amateurs. It is capable of many modifications, and almost each practitioner adopts some little variation which his own experience suggests. The following will be found a very neat and certain method of working:—

Prepare the plate with a bromo-iodized collodion, and sensitize in a slightly acid 35-grain nitrate bath, then wash it well; next re-sensitize the plate in a five-grain nitrate of silver bath. When the plate comes out of this latter, drain it well, and pour over the following solution:—

Albumen	...	...	...	1 ounce.
Water	...	...	...	9 ounces.
Chloride of ammonia	...	...	...	5 grains.

Allow this solution to soak well into the film, then pour it off, and finally wash well and dry.

This process is very certain, and provided the collodion is of the proper kind, and the manipulations carefully performed, the plates will develop without any stains or defects. Under the proper conditions, that is, away from damp, noxious vapours, and light, they will keep their sensitiveness unimpaired for many months. Either gallic acid or pyrogallie may be used for developing, as in the preceding process, but the latter is generally used.

The remarks made respecting the development in describing the collodio-albumen process, equally apply to this one. Hyposulphite of soda is the best fixer.

IMPROVED FOTHERGILL PROCESS.

Obey all the directions given for the preceding process up to the point of immersing the plate in the five-grain nitrate bath, when, instead of doing that, put it in a dish containing solution of chloride of ammonia, five grains per ounce; allow it to remain a few minutes, or until another plate is ready, then take it out and wash it well. Next pour over its surface sufficient of the following solution to soak well in, viz :—

White of egg	...	...	...	1 ounce.
Water	...	...	...	5 ounces.
Ammonia	...	...	...	10 drops.

Beat this into a froth and filter. When this has well soaked into the plate, wash the albuminous solution off, and pour

over the surface gallic acid solution, as recommended on page 52.

After this final wash of gallic acid dry the plates carefully. The exposure will be about five times longer than wet collodion; the results are very fine. Develop with pyrogallic solution; fix with hyposulphite.

MODIFIED FOTHERGILL PROCESS.

This modification was made to remove the uncertainty attendant on the mixing of the free nitrate retained in the film in plates prepared by the Fothergill plan, with the albuminous preservative solution. If the nitrate be in excess, the plates are staidy and dirty, and do not keep; if the washing be too much, or the albumen too great, the plates are insensitive; or if the nitrate and the albumen unite irregularly, the plate is full of stains. To obviate this, Mr. Bartholomew and Mr. Hannaford suggested that these troubles would cease if the plate were well washed to remove all free nitrate, and the necessary silver added to the albuminous solution before applying to the plate. This plan is very reasonable, and removes much of the causes of uncertainty of the original Fothergill process. The following is Mr. Hannaford's method:—To the white of one egg add three ounces of water, and about ten or fifteen minims of ammonia. Beat this in the usual manner until limpidity is produced, and then add a drachm of a 30-grain nitrate of silver bath solution. A milky precipitate will be formed; add ammonia a few drops at a time, agitating well until the precipitate is redissolved, or until it is only slightly milky. Use a collodion suitable for dry processes. After removal from the bath, thoroughly wash under the tap, or in a large quantity of water—this cannot be too effectually done,—then

drain perfectly. The plate should be *completely* drained, for if any quantity of water remains, the albumen solution will not readily mix with it, and markings from unequal action will thus arise. If the albumen contains a large excess of ammonia, this danger of stains is got rid of, as the solution in such case readily mixes with water; but excess of ammonia has a tendency to dissolve out certain organic salts that are formed in the film. This loss weakens the intensity, and unless the action be equal at all points, unequal development will result. It is, therefore, not advisable to have ammonia in excess in the albumen.

The plate completely drained should have the albumen poured off and on two or three times, and then allowed to remain while another plate is being prepared. Lastly, it is to be thoroughly washed, drained, and spontaneously dried. As the albumen solution undergoes no change but slight dilution, it may be used a great number of times. An ounce will be sufficient for a dozen stereoscopic plates.

PETSCHLER AND MANN'S PROCESS.

This is a variation of the Fothergill process, by which the plates may be prepared and kept in an insensitve condition for an indefinite time, and yet by simply immersing in water have their sensitiveness restored to them. The method commends itself especially to the attention of travellers.

The plate is prepared in the usual manner with a good bromo-iodized collodion, sensitized, and then immersed in a dish of common water, where it remains while another plate is being sensitized. Take it out, pour more water on it till the greasy lines disappear, and then pour over it the following albumen solution:—

Whites of	...	...	6 eggs.
Distilled water	...	...	3 ounces.
Chloride of sodium	...	...	18 grains.
Liquor ammonia	...	...	60 minims.

Dissolve the salt in the water, add the ammonia and mix with the albumen; beat all to a froth, and let it stand a day; filter through sponge. Pour this albumen on the prepared plate carefully to avoid marks, let it soak into the film, pour it off, and set the plate aside to dry. The plates, when dry, are almost entirely insensitive to light. They can be made sensitive at any time by soaking for about ten minutes in plain water, washing well, and finishing, if possible, with distilled water; when dry they are ready for the camera. The exposure and development is the same as for the Fothergill process.

THE HOT-WATER PROCESS.

This is another variation of the Fothergill process; it was originally suggested by Dr. RYLEY, but subsequently, and quite independently, worked out by Mr. JOHN PARRY, of Manchester. The latter gentleman thus details his method:—"I coat the plate in the usual manner with collodion; sensitize and wash, first in a large dish, afterwards under the tap, allow it to drain a minute or two, and then float over an uniodized solution, say one ounce of albumen to one ounce of water, and after draining a short time, and before it has time to set, immerse in a suitable vessel of very hot water, say for half a minute; wipe the back of the plate and set it in a dark place to dry, when the plate is ready for use.

"The conveniences of the above plan I find to be cleanliness of development and entire freedom from blisters."

All the other operations of development, &c., are the same as for the usual Fothergill, or collodio-albumen processes.

DR. RYLEY'S MODIFIED FOTHERGILL PROCESS.

The plate has to be sensitized as usual, and thoroughly well washed. Coat the plate with the following solution of albumen :—

Albumen	...	...	...	...	1 minim.
Water	...	...	...	...	2 ounces.
Ammonia	...	...	...	...	30 minims.

Beat well up to a froth, allow it to settle, and filter before use. Pour sufficient of this over the plate to cover it; let it flow backwards and forwards to soak into the film. Pour the albuminous solution away, and thoroughly wash the plate, the last rinsing being with distilled water. Let the plate dry. When perfectly dry, moisten the plate with distilled water, and pour over the following solution :—

Tannin	...	...	...	...	1 grain.
Gallic acid	...	...	...	...	1 „
Water	...	...	...	...	1 ounce.

Filter the solution before using. Pour it on and off the plate to well permeate the film, then set the plate up to drain, and dry, without washing off this tannin and gallic acid solution. When surface dry, finish by the heat of a dull fire.

These plates retain their sensitiveness well; Mr. Morley, of Islington, recently exhibited a negative that had been sensitized six months before exposure, and it was as perfect as plates newly prepared. The development of the plates may be in the same manner as by the Fothergill or collodio-albumen processes, the same directions and manipulations being equally applicable.

The peculiarity of this modification consists in the final wash of gallic acid and tannin *after the prepared plate has become dry*. This corresponds with the last sensitizing in the nitrate bath in the collodio-albumen, and the final wash in Petschler and Mann's modification. Dr. Ryley found that hot water would answer a similar purpose; Mr. Parry afterwards independently discovered the utility of the finishing with hot water, and embodied it in the modification known as the "Hot Water Process." Dr. Ryley finally gave the preference to the gallic acid, or tannin, or a mixture of both.

Major Russell had observed the virtues of a final wash of gallic acid prior to his discovery of the tannin process.

An interesting experiment was tried by Mr. Morley to test the utility of this final wash of gallic acid. On one occasion, having some Fothergill plates prepared in the usual manner, but which, on examination prior to exposure, looked very unsatisfactory, having stains and markings of an annoying character very plainly evident, he determined to test the usefulness of the gallic acid. Upon a particular plate he poured, but on one-half only, a solution of gallic acid. The plate was dried, exposed, and developed as usual, and on the half without gallic acid, the image was poor, weak, and dirty; while the other side was brilliant, clean, stainless, and all that was to be desired.

This method is, therefore, strongly recommended to the attention of amateurs, as well as the profession, as a certain means of producing a dry plate that may really be depended on.

In developing these plates, care must be taken not to make them too intense, as they become of such a strong non-actinic colour, that very little density is required, or the pictures will be hard and wiry.

IMPROVED METHOD OF DEVELOPMENT FOR DRY PLATES.

The following mode of development has been recommended by Mr. MUDD, and his assistant, Mr. WARDLEY, as affording a more certain plan of securing delicacy of detail in the development.

After the dry sensitive plate has been exposed in the camera, it is wetted with clean water, and a newly prepared plain solution of pyro, 3 grains to the ounce, *without any acid*, is poured over the surface; the picture will quickly make its appearance without the addition of silver or acid. The development must be continued until all the details in the deepest shadows are brought out. The image will then be very thin and wanting contrast. To obtain the necessary intensity use the following solution:—

Pyrogallic acid	...	...	2 grains.
Citric acid	...	...	2 „
Water	...	...	1 ounce.

Add to this at time of using a few drops of 30-grain nitrate of silver solution. Continue the development until the required opacity in the high lights is obtained.

The advantage of this modification is the separation of the developing and intensifying processes, so that the operator has more control over his picture from over or under exposure. For, if the plate be under-exposed, the development may be continued until all the details in shadow are fully shown, without any fear of the high lights being spoilt from excessive intensity; and if over-exposed, there is no risk of the shaded parts acquiring the same intensity as the strongly lighted ones.

This method is equally applicable to all the dry processes, especially for the rapid ones, and where a short exposure has been given. It is getting into such general practice, and is found to be so safe and certain, that it will probably be soon considered as the only proper mode of development, always excepting the cases where the plate has been re-dipped in the nitrate bath. In such instances it is quite inapplicable.

The method of development adopted by Major Russell in cases of short exposure (see page 61) is but an extension of this principle, where he not only does not add acid to the pyro, but positively makes it alkaline. It is probable that this alkaline developer is fully as applicable to all varieties of collodio-albumen and Fothergill plates as to those prepared with tannin.

ON THE USE OF HOT DEVELOPING SOLUTIONS.

ONE of the chief objections to the dry processes is the increased length of exposure required as compared with the wet. Recent experiments tend to show that this objection may be somewhat removed by the use of hot developing solutions. Sufficient experience has not yet been acquired to speak very confidently, because in different persons' hands the results vary, some being successful, while others fail under apparently similar circumstances; but in many processes that a much shorter exposure may be given if the following instructions be observed:—After exposure, immerse the plate in a solution of *hot* water, say 120° ; after draining, pour over it the developing solution, which may be either saturated solution of gallic acid, or plain pyrogallic solution, two grains to the ounce, but without acid or silver. Judgment must be exercised in this stage of the process, or the plate may fog

under the influence of the heat; if the image start out at once in all its details, the heat used has been more than was necessary, and the plate must be allowed to get cold before proceeding to intensify. If the image appear slowly and reluctantly, the developer may be poured off, the plate washed, and a fresh quantity of hot water poured over. Replace this with fresh developer, and the development will start anew; but it is better not to add any silver until all the details are out. Allow the plate then to cool, and proceed to intensify as usual. A plate that is fully exposed in the camera should never have heat applied in the development. Heat may be regarded as a substitute for light, and only so much should be used as is necessary to complete what light itself would have effected, if the plate had been longer exposed. Heat may thus be considered a remedy for under-exposure. It must, of course, be used cautiously, as it is impossible to exactly tell until development how much any given plate is under-exposed. A proper method of proceeding will, therefore, be to first moisten the plate with tepid water, then pour on the plain pyro developer, and, accordingly as the plate behaves, form an idea of how much heat may safely be employed. If the image appear very slowly, only the strongest lights showing—a reasonable time being given for the developer to penetrate the film—then use more water of a higher temperature, and apply the pyro again; if the image be still more tardy, more hot water and fresh pyro, as well as more patience. As a final resource, the developing solution may also be made very hot, but it will be better not to be hurried, and to employ a lower temperature and more time, than a very hot solution for a shorter period. This is the only rational plan of using hot solutions, until experience is gained to know exactly how much heat can be

safely applied. The images obtained will always be very weak and thin, and the intensity must be produced by a second application of acid, pyro, and silver.

From the above observations it will be gathered that heat is only an auxiliary to light and the developer, and that wherever it can be dispensed with it will be well to do so. Its aid should be called in on emergencies only. Some collodions split and break up under its influence, and others persist in fogging. It has been most successfully applied in the collodio-albumen and plain tannin processes; and as these are the slowest, its influence is best shown where most needed. Mr. H. Cooper found that plates prepared with plain tannin were made *twenty* times quicker by heat, but those produced by the more rapid means of tannin and honey were only one-half quicker. No means are yet known by which it can be advantageously applied to quicken the ordinary wet process.

BROMIDE OF SILVER PROCESS, BY MAJOR RUSSELL.

The experiences of all dry-plate photographers agree as to the importance of the collodion containing a bromide as well as an iodide salt. Major RUSSELL has successfully been increasing the relative proportion of the bromide, until at last the iodide is banished altogether. Years since, Mr. Crookes, Sir John Herschel, the late Mr. Berry, and the Abbé Laborde gave formulæ for an exclusively bromized collodion; but they were for the wet process, and as the image produced by such collodion was wanting in vigour, and had some other drawbacks, slowness being one, the processes fell into abeyance.

The experiments and experience of Major Russell have convinced him that with tannin plates a simply bromized

collodion is more sensitive than one prepared with a mixture of an iodide and bromide.

Some of the peculiarities of the process are contained in the following notes, which Major RUSSELL has kindly furnished to the author for publication :—

1st. The pyroxyline should be of a somewhat different kind to that which is best suited to iodized collodion. It should be prepared with stronger acids, or at lower temperature with longer immersion, and the collodion should set quickly.

2nd. The bromide should be in larger proportion, and the pyroxyline in smaller, than when the iodide is used. More ether than alcohol may be required, but it is best to use as little ether as will make the collodion work and set well. A suitable pyroxyline will work well with equal parts of ether and alcohol.

3rd. The nitrate bath should be stronger, and the time the plate is kept in should be longer than usual, as the conversion of the bromide of silver is slower than iodide.

4th. Bromized collodion, though far more sensitive than iodized, develops less easily when the usual developer—pyro, acetic acid, and silver—is employed. It works best with the alkaline developer, which alone will often produce sufficient intensity in an hour or two, during which time the plate requires no attention, as the mottled markings in the film will not appear as with a silver developer left at rest.

The manipulations are as follows :—If the film exhibit a tendency to leave the glass, it may be first coated with a weak gelatine solution ; or better, paint round the edges of the glass with a $2\frac{1}{2}$ -grain gelatine solution (if the glasses are previously warmed, it will dry as fast as it is laid on). When cold, cover with a weak solution of india rubber and amber in

chloroform and benzole, and dry by heat. If a number of glasses are so treated, a few seconds each will complete the preparation. The collodion is made of the pyroxyline already described, and which is of a *horny* character, that sets quickly :—

Pyroxyline	...	...	...	5 grains.
Bromide of cadmium	...	...	8	„
Alcohol 805°	...	...	3	drachms.
Ether...	...	...	5	„

Excite in a 60-grain nitrate bath, saturated with bromide of silver, and keep the plate in the bath fifteen or twenty minutes; this will form a very creamy film. Wash the plate thoroughly after sensitizing, and coat it with a solution of tannin, 8 grains to the ounce. After this has well permeated the film, wash well again, and dry the plate. Give a short exposure in the camera, and develop with carbonate of ammonia and pyrogallie, as described on page 61.

The reader's attention is invited for further particulars to Major RUSSELL's excellent treatise on the Tannin Process, second edition.

EXPERIMENTAL EXAMINATION OF VARIOUS DRY PROCESSES.

The author feels he cannot better conclude the narration of the different means by which the collodion plate can be made to retain its sensitiveness in a dry state, than by introducing the following series of interesting and valuable experiments (originally published in the "PHOTOGRAPHIC NEWS," and now reproduced, by permission), not only for the useful information afforded, but also as a model method of experimenting for photographers to copy.

Comparative experiments with different processes are often vitiated by the foregone conclusions of the operator, or by the hasty and imperfect method in which they are conducted. The present series, however, derive a value from the known skill and ability of the experimenter, Mr. Henry Cooper, jun., and his thorough unprejudiced character.

His experiments are thus detailed :—“ During the last four months I have been making experiments to ascertain which is the simplest, most sensitive, and surest of the dry processes. The processes I took to experiment upon were the tannin, Mr. England’s modification of ditto, the morphine, alkaline gelatine, alkaline resin, plain washed collodion, and morphine resin. The collodion was a mixture of Ponting’s, and one iodized with iodide of potassium and cadmium, and bromide of cadmium. The bath, 35 grains of nitrate of silver, and 1-10th of a minim of acetic acid to the ounce. I prepared six plates by each of the above methods. I will give a short epitome of my method of preparing them, so that a more definite conclusion may be drawn between the conflicting merits of each :—

“1. *The Tannin*.—Coated and sensitized a perfectly clean plate, washed thoroughly, and coated with solution of tannin 15 grains to the ounce. I ran a brush-full of varnish, prepared as follows, round all the plates to prevent slipping of the film :—The varnish : 1 drachm of shellac and 1 drachm of fused gum benzoine to enough alcohol to form a solution about double as thick as Sœhnée varnish. The advantage of this solution is, that it adheres firmly to the glass, but can be easily removed by alcohol, to which a little nitric acid has been added.

“2. *Mr. England’s Modification of the Tannin*.—Proceeded as before, but coated with—

Tannin	...	...	...	...	15 grains
Pure honey	...	...	...	...	16 ,,

to the ounce of water.

"3. *The Morphine*.—Took a good working negative bath strongly acid, and added $\frac{1}{4}$ grain of nitrate of morphine, previously dissolved in a little distilled water, and filtered out the deposit. Coated and sensitized the plates; thoroughly washed and dried.

"4. *Alkaline Gelatine*.—Coated and sensitized a plate in the ordinary bath, washed and coated with a warm solution of gelatine, 15 grains to the ounce. I forgot to say, that before coating with gelatine I added 5 grains of carbonate of soda to the salt bath used for soaking the plates in.

"5. *Alkaline Resin*.—Added 1 grain of gum guacium to each ounce of collodion, coated and sensitized the plates in the ordinary bath, washed, soaked in the alkaline and salt bath used for the last plates for five minutes, washed, and dried.

"6. *Plain Washed Collodion*.—Simply washed a sensitive plate in an unlimited quantity of water, and dried.

"7. *Morphine and Resin*.—Sensitized a plate coated with the collodion containing the gum guacium, in the morphinized bath. Being determined to give them a fair trial, I kept them all for three weeks. Then I took, as my standard of sensitiveness, Ponting's collodion, and a nearly neutral bath, with which I have taken negatives in one-third of a second. Exposed each kind on same day, on same subject, &c. The results were as follows:—

"1. The tannin developed with pyrogallie acid, after being wetted with cold water, required *twenty* times as long as the wet plate. One wetted with water at 160° required *twice* as long as the wet plate; but the film required *great* care to prevent its slipping. I lost the first plate I tried by this

method, by *dipping* in the fixing bath (hypo); for, on washing it very carefully, to my great astonishment, the film, which had appeared perfectly firm, slipped off, so that I saw the picture slowly float down the sink.

"2. Mr. England's modification required, with cold water, twice as long as the wet, and with water at 120°, half as long again; so that it will be seen that the hot water did not exert the same accelerating effect as in the tannin prepared by Major Russell's method.

"3. *The Morphine* I found to be about equal in sensitiveness to Mr. England's tannin, but yielding a much softer negative, and being, also, more free from stains, &c.; so that, on the whole, I prefer the morphine, for which every photographer ought to thank Mr. Bartholomew.

"4. On proceeding with my experiments on the alkaline gelatine, I was much disappointed in this process, as I had hoped, at first, great things from it. With cold water it required three times the exposure of the standard wet plate; with hot it took about the same time as the wet, but the picture was covered with a fog, which could not be rubbed off. Some might fancy that this fog was produced by over-exposure, but to test it I exposed a plate for a much less time, when only the high lights appeared, but the same annoying fog appeared in full vigour. Great care is also necessary in the preparation of the plates, to prevent a network formation covering the bottom of the negative. It is produced if the soda be mixed with the gelatine, or if the soda be not thoroughly removed by washing, if applied before or after the gelatine.

"5. The alkaline resin I found to be less sensitive than the preceding, but easier to work.

"6. With the plain washed collodion I have had some very

curious results. Some two months ago, I prepared a batch of plates by this process. After spoiling a good many, I succeeded in the following way:—Expose for same time as wet collodion, soak for two minutes in distilled water, then just *dip* in the bath, wipe the back, and develop with—

Sulphate of iron	...	...	...	15 grains
Sulphate of copper	...	...	...	10 „
Acetate of soda	...	...	...	1 grain
Citric acid	...	...	...	1 „
Acetic acid	...	...	...	15 minims
Water	...	...	...	1 ounce.

“The negatives developed in this manner were very fine, all that could be wished, soft and brilliant.

“On exposing and developing one of the six prepared with the others for these experiments I was astonished to find not even the trace of an image after prolonged development. In the last week’s “*News*” a correspondent writes to say that he has met with something very similar; but it appears he used no silver in developing, which would easily account for it; but mine was dipped in the bath. I then exposed one for five minutes with no better result. Thinking that something might be wrong with the developer, I exposed one and developed it in a totally different way with fresh chemicals, as also the remaining three plates, each in a different way, but the film remained perfectly white and clear, no kind of stain of any kind, or any trace of an image appearing. I have not had time since to prepare any fresh plates, but I soon hope to do so, when perhaps I may find some solution of this strange behaviour of the film.

“7. *The Morphine Resin* I found to be very clean, bearing a good deal of rough usage, and being nearly as sensitive as the plain washed *morphine*.

"Having heard a good deal of Dr. Norris's plates being developed satisfactorily with hot water after a very short exposure, I procured some of those plates, and the results were quite sufficient to justify the praise which they have received. I am afraid that this paper has exceeded the ordinary limits, but those who have had to write on subjects in which every detail is important, know how difficult it is to express oneself clearly, and so that no one may be misled, in a short space. Pleading this as my excuse, I will only ask those who have time to make carefully some such experiments as I have endeavoured to explain, so that we may soon reach the 'consummation devoutly to be wished,' an instantaneous dry process."

PART III.

CONCERNING SUCCESSFUL PHOTOGRAPHY.

THE period is long past since a photograph was capable of giving pleasure, simply because it was a photograph. The art has so progressed, and the world become so familiar with it, that a photograph must now be something more than merely correct; it must furnish a favourable, a pleasing representation, in order to secure attention. That photography is capable of pleasingly and favourably representing persons and objects, is proved by the works of the most distinguished practitioners. A point in the history of the art has then been reached in which merely taking a photograph has ceased to be a distinction; the acquisition must now add to the pleasurable emotions in order to have a value. Unless this is attained, the photographs are said to be "not successful."

In what, then, does "successful photography" consist? How does it differ from simple photography—photography that is not successful? and what means are to be adopted to produce "successful" photographs? These inquiries are more suggestive, and demand fuller replies than the limits of this small work afford; yet such a broad and general answer may be given that will satisfy the mind, and also have a *practical* end.

All men love Truth—all men love Beauty; photography claims to stand on the one, and to represent the other; and it is "successful" only so far as it accomplishes these pretensions.

Photography makes the primary claim, *that it is true*; a photograph cannot, therefore, be successful if it be not true. Suppose a landscape in June to appear with the trees as if

covered with snow, or a cathedral with the vertical lines twisted, and the building as falling; or water as cotton wool, and trees as huge feathers; or black hair appear as grey, and grey hair as white; or white muslin like white chalk, and blue eyes like no eyes; such photographs clearly cannot be successful, simply because they are not true. But mere literal truth does not always represent general truth; a portrait of a person, or view of a building, may be taken from some unfortunate point of sight, so that the person or building shall cease to be recognised. Such pictures, though literally true, are practically false, and, therefore, deservedly unsuccessful.

Simple truth, though an indispensable element in a successful photograph, is rarely sufficient alone. Truth is many-sided; it has its happy and its miserable aspect; its cheerful and its cheerless side, its attractive and its repulsive form; and the "success" of the photograph largely depends on the selection of the lovely, and the rejection of the unpleasant; in other words, in clothing the strength of Truth with the attractions of Beauty.

Truth, without Beauty, may be hideous from its very truthfulness; and Beauty, without Truth, is a worthless sham: but to the attractions of Truth and Beauty combined there is no bound, and to their happy union the works of the most distinguished photographers owe their great "success," as witnessed particularly in wet collodion by Bedford, Wilson, Williams, Heath, and England; on dry plates by James Mudd; in copying works of art by Thurston Thompson; in instantaneous and atmospheric effects by Col. Stuart Wortley, Breeze, and Blanchard; and in *genre* and general composition by Robinson and Rejlander.

No argument can be necessary to prove the two-fold

purpose of photography. Its truthfulness is rarely questioned, but that it should minister to the other passion is known more by an inner, unspoken craving, than by definite words. Simple truth is not enough, every one wants to have the photograph "beautiful." Some aspects of the landscape are more bewitching than others; at some period of the day the old church is more picturesque than at another; some views of the face are more attractive than the rest; and when popular feeling suggests these as the best conditions, it tacitly acknowledges the duty of photography to seize truth when invested with its highest degree of beauty.

To the question, then, in what consists "successful photography?" the answer is, in adequately and pleasingly representing objects so as to combine both truth and beauty; and it becomes "successful" by virtue of succeeding in what it attempts. It differs from unsuccessful photography, because the latter only partially succeeds in depicting objects, and too often offends by the unhappy aspect in which this imperfect truth is represented.

To the still further question, what is to be done to produce "successful photographs?" the reply is to imitate the practice of "successful" men, who, imbued with these correct principles, seize the most beautiful aspects of whatever they attempt, and are never satisfied unless they obtain something approaching to their own high standard of excellence.

ON THE USE OF ALCOHOL IN THE DEVELOPER.

It is not generally understood the exact part that alcohol plays in a developing solution. Photographically, it is inert; it neither develops like the pyrogallie acid or protosulphate of iron, nor checks and controls like the acetic and citric acids. It acts only as a *mixer*; it makes the developing solution

more of the nature of the nitrate of silver solution that floats on the plate. When a plate is excited in a newly-made nitrate of silver bath, a developing solution without alcohol will readily flow over it, but as the bath becomes used, some of the ether and alcohol from the collodion is dissolved in the bath, and the plate then becomes more *oily* on its surface, and more repellant of water. A developer without alcohol will not, under these circumstances, flow easily over; it hesitates, flows over the edge, and will not readily mix with the nitrate of silver, because the latter, holding ether and alcohol in solution, repels it. Alcohol added to the developer, however, makes it more like the nitrate of silver in constitution, and hence they readily mix. From this it is seen that the newer or less used the nitrate bath, the less alcohol needed in the developer; and also, that the older the bath, or the more ether and alcohol it contains the more there is required in the developer. When the latter, therefore, does not readily mix with the nitrate on the plate, as much alcohol must be added as will make it easily blend.

The quantity of alcohol required in the developer cannot be a constant quantity, it always varies with the condition of the bath and other things; with a new bath none is required, but with an old used one as much as a drachm to each ounce of solution may be necessary. In summer, more is needed than in winter; strong solutions require more than weak ones, and the lesser the quantity of acetic acid, the more need for the alcohol. No formula can, therefore, ever give the exact amount required, but each person, when the real use is known, can add just the quantity, and no more, that his plate requires. In place, therefore, of naming an exact quantity in a formula, a very sensible practice is being generally adopted of giving "*quantum suff.*" as the proportion of alcohol.

INTENSE IRON DEVELOPERS.

WITH some samples of collodion, and in a weak light, the ordinary iron developer produces only a thin grey image that will not readily intensify. Under such circumstances it is better to try a different developer. The following formulæ are supplied to meet this want. It is for the operator to select that one that he finds most suitable. The proportions of alcohol is not mentioned for the reasons given on page 90.

No. 1.

Protosulphate of iron	...	...	12 grains.
Acetate of soda...	...	...	6 „
Glacial acetic acid	...	...	30 minims.
Water	...	...	1 ounce.

This developer requires care in using, or stains will be produced. It should not stop on the plate quite so long as a simple solution of protosulphate of iron, as it has greater fogging tendencies. A larger quantity of the iron, or a lesser quantity of the soda, may be used than the above, if the proportions given are not found to be manageable.

No. 2.

Protosulphate of iron	...	...	1 drachm.
Acetate of lead (pure)	...	...	$\frac{1}{2}$ „
Glacial acetic acid	...	...	$\frac{1}{4}$ ounce.
Water	...	...	5 ounces.

Dissolve the acetate in one half the water, and the iron in the other, mix, let the precipitate settle, filter the clear fluid and add the acid. This, like the preceding solution, requires care in its use to avoid stains. The pictures produced are very dense.

No. 3.

Protosulphate of iron	...	...	1 drachm.
Tartaric acid	...	...	1 „
Nitric acid	...	...	15 minims.
Water	...	...	4 ounces.

This produces a peculiar clean bluish black picture.

No. 4.

Protosulphate of iron	...	...	1 drachm.
Ammonia	...	...	15 minims.
Glacial acetic acid	...	...	1 drachm.
Water	...	...	4 ounces.

Dissolve the iron in the water, add the ammonia to the acetic acid, and when effervescence ceases, add the mixture to the iron solution. Mr. V. Blanchard speaks very highly of the above compound, as furnishing negatives that frequently require no after intensifying.

No. 5.

Sulphate of iron and ammonia	...	...	2 drachms.
Glacial acetic acid	...	...	1 drachm.
Water	...	...	4 ounces.

This is a solution of the new iron salt that seems likely to supersede the ordinary protosulphate. It appears to act much the same as the latter, but gives more intensity. It is very clean and manageable.

No. 6.

Protosulphate of iron	...	...	30 grains.
Boracic acid	...	...	10 „

An easily made and good developer.

No. 7.

Protosulphate of iron	...	...	20 grains.
Tartaric acid	...	...	15 „
Glacial acetic acid	...	...	15 minims.
Water	...	...	1 ounce.

An excellent developer; the image is quite black and will not show as a positive. It is not adapted for a professional, who shows his negatives as positives for his patrons to judge from. For other purposes it is excellent.

No. 8.

Protosulphate of iron	...	...	60 grains.
Citric acid	...	...	10 „

This is a peculiar developer, giving very clean pictures. It is not equally suitable for all collodions.

No. 9.

A {	Protosulphate of iron	...	1 drachm.
	Water	...	4 ounces.
B {	Pyrogallic acid	...	8 grains.
	Water	...	4 ounces.

Dissolve A and B separately, mix them, and a deep blue black precipitate will form. Add carefully sufficient of a saturated solution of citric acid in water until this precipitate is re-dissolved. Mr. Tunny of Edinburgh, who is the author of this formula, considers it to be the best developer extant. When poured on the plate, there is apparently no immediate effect for a short time, but presently the image comes out with great vigour.

HOW TO CLEAN GLASS PLATES.

An excellent starting point of success is to obtain a nice clean plate. A good operator knows that unless his glass is

clean he has no security for obtaining a perfect picture. Many different methods have been given for effecting this apparently simple object, but the plan that seems to be perfection with one person, is declared to be useless by another.

New glass plates are always best; old plates many times used, or that have laid about with their dirty surfaces, or that have been varnished, are always to be regarded with suspicion. It is very doubtful if there is any saving in using a plate that has once been varnished. A truly economical photographer will have the courage to use the hammer to lots of his old glass rather than risk his materials, his time, and his temper on plates which may give only dirty pictures. The chemicals, especially the protosulphate of iron and cyanide of potassium, seem to act on the surface of the glass, so that after much using no amount of friction with acids or alkalies will prevent smears, marks, *ghosts*, comets, rockets, and other abominations. New glass works well with very little cleaning. Patent plate is always the best; but for small sizes, up to 5 by 4, "flatted crown" will do, and "polished sheet" for larger sizes. It is a good plan, if there be a doubt whether the glass plates are flat enough, to put them into the printing frame, and apply quite as much pressure as will occur in printing, for few things are more mortifying than to break a negative through using glass not flat.

To prevent cutting the fingers and tearing the cloths, the glasses should have their sharp edges and corners taken off, and to make the collodion adhere well at the edges, it is better if they are roughened a quarter of an inch all round. Sand paper, emery cloth, sandstone, or a little grooved instrument made of corundum and sold for the purpose at most photographic dealers, may be used.

New glasses may be simply washed under the tap with plenty of water, and dried on clean cloths. When quite dry, place the glass in a plate-cleaning holder, and pour on a few drops of pure alcohol; rub this well over the plate on both sides with a tuft of cotton wool. With a second tuft rub off the alcohol, and with a third one polish the plate. This will be found a safe and expeditious method of cleaning plates. The last tuft of cotton should be kept quite clean and dry, so as to leave the plate without lines or smears. If the reader has much trouble with dirty glasses, he is strongly recommended to try "Werge's Plate Cleaning Solution." The writer has used it for years, and is never troubled with dirty plates, and he feels he is doing his readers a service in calling their attention to this very useful preparation.

Every dark room should have a large dish provided, half filled with clean water, into which all spoiled plates should be immediately immersed, so that the collodion film should not dry on the plate. By this plan much time will be saved in cleaning the glasses, and the plates will be kept in better order. The plates should not be left to lie in this water any longer than possible, and the water should be frequently changed. The fragments of collodion films should be added to the pan in which the silver residues are kept, as they all help to swell the amount.

The above simple means may not be satisfactory to some persons for cleaning their glasses, therefore the following plate-cleaning solutions are given, culled from a variety of sources:—

GLASS PLATE CLEANING SOLUTIONS.

No. 1. (Mr. Hardwich).

Make a cream of tripoli powder and spirits of wine, add a little ammonia; dip a tuft of cotton in the above, and rub

the glasses for a few minutes, rinse them well in plain water, and dry on a clean cloth kept for the purpose, which cloth should be washed in pure water, or water containing a little common washing soda, but not with soap and water. Polish the plates with an old silk handkerchief, or clean chamois leather.

No. 2. (Mr. Hardwich).

Liquor potassæ 1 ounce.

Water 4 „

Wet the glasses well on both sides with the above, using a cylindrical roll of flannel to protect the fingers; allow them to stand while several are so treated. Wash them well, dry, and polish.

No. 3. (Mr. Lake Price).

Wash the plate with abundance of clean water running from a tap, wipe with old linen cloths kept scrupulously clean, and retained for the purpose. Polish with clean chamois leather, or old silk. If the plates are greasy, give them a preliminary wash in warm soda water; if they have been previously used, let them lie for six hours in a strong solution of caustic potash with thin slips of firewood between them to ensure the surface being acted on. When cleaning the plates, wear a pair of white cotton gloves to prevent the plate or the cloths being contaminated with the perspiration from the hands.

No. 4. (Mr. Sutton).

Rub the glass plate on both sides with a piece of flannel dipped in a thick mixture of whiting and water; wash off the whiting thoroughly, and put the plate in water acidified with nitric acid; wash again, and wipe dry with a clean cloth kept for the purpose, and which must never be washed with soap. Before using, polish with a silk handkerchief.

No. 5. (Mr. Thomas).

Prepared tripoli...	...	...	2	ounces.
Water ...	...	...	3½	„
Spirits of wine ...	...	...	4	„
Solution of caustic potash	...	...	½	„

With a tuft of cotton wool rub the plate well with the above mixture, wash the mixture off under the tap with another tuft, being careful to get the tripoli from the roughened edges. Let the plate remain in a deep dish of water till six plates are thus treated; take them out singly, wiping the edges with a tuft of cotton, and pass them through a dish of distilled water. Dry them with cloths washed without soap. Polish with chamois leather, and finish with a silk handkerchief.

No. 6. (Mr. Crookes).

Place two handfuls of common salt in a jug, and pour a pint of boiling water over it. Stir for some time, allow to get cold, and filter. Mix together equal parts of fine rotten stone and tripoli, and add about a teaspoonful to every six ounces of the above saturated solution of common salt. To use, shake the bottle well, and smear a little of the mixture over the plate with a rag. Now clean it well off by briskly rubbing with a clean cloth, and give the last polish in the usual manner. The crystallization of salt which takes place on the surface of the plate when the mixture is smeared over seems to loosen the dirt from the surface in a remarkable manner, and the after friction with the cloth brings away all impurities. Care must be taken that no salt is left on the edges of the plate, or it will decompose the bath.

In relation to the above, Mr. Crookes says, "That if the receipt be properly used, a failure from the employment of dirty glasses may be looked upon as a thing of the past."

No. 7. (Mr. W. Miers).

Water	...	...	...	1 ounce.
Hydrochloric acid...	...	...	...	2 drachms.
Iodine	...	...	...	a few grains.

Rub the plates over with a pad of cloth saturated with the above liquid, use a circular motion, and polish as usual.

No. 8. (Mr. G. Wharton Simpson).

Nitric acid	...	...	...	1 drachm.
Alcohol	...	...	...	1 ounce.

Tripoli, sufficient to make a creamy paste.

Rub the plates well on both sides with the above paste, and set them aside to dry. In this condition they may be stored away; when required for use, rub the tripoli off with a fine clean cloth, and polish with a clean chamois leather.

TO CLEAN PLATES THAT HAVE BEEN VARNISHED.

Soak the plates in a saturated solution of common washing soda, and allow them to remain until the film comes off without any friction. If the solution is made hot, a few minutes will be sufficient; but cold, they usually require from 24 to 48 hours soaking. When the film leaves the glass freely, wash it well under the tap, and immerse it in weak nitric acid (water 5 ounces, nitric acid 1 ounce), for a short time. Wash well again, dry, and treat it as a new glass.

As the varnished side can never be much depended on, it is a good plan to mark the *unvarnished* side with a diamond before cleaning, and to use the marked side for putting the next collodion film upon.

"CARTE DE VISITE" PORTRAITS.

THE distinguishing characteristic of these portraits is their including a full length. The position may be sitting or standing, but the feet must be introduced. This constitutes the charm of the picture, for the photograph is no longer a fragmentary representation of a half or three-quarter length, or a mere head, but comprises a complete portrait of the whole person. Thus a skilful artist may, in these pictures, produce more natural likenesses by rendering accurately not only the features, but also the proportions and form of the figure, together with many of those peculiarities of dress and deportment that constitute the idiosyncrasy of the individual. Great scope is also afforded for the introduction of appropriate accessories, drapery and backgrounds, so as to form not only accurate likenesses, but also pleasing pictures.

The position may be either sitting or standing, the latter being most usually selected as better displaying the form and proportion of the individual. It is here the true artist will shine in the selection of such arrangements and disposition as accords with the character of his sitter. No rules can be laid down but such as good taste, and the exigencies of the moment, or the peculiarities of the individual, may suggest.

These little pictures permit the introduction of many graceful additions, which materially enhance pictorial effect. Drapery, balustrades, columns, pedestals, vases, handsome chairs and tables, footstools, couches, all find their appropriate places when arranged by the hand of taste. Painted backgrounds may be judiciously used, but they require care in their management to avoid theatrical effects and noisy display. They should always be quiet, retiring, and unobtrusive, and

in complete harmony with the portrait. Unless so used, they had much better be abandoned, for, by the use of other accessories, they can always be dispensed with. Nothing can be more unpleasing than to see a portrait of a person surrounded with a crowd of incongruous objects, and it becomes almost painful to see the same things monotonously repeated in the portraits of a number of friends.

As these portraits are so small, it is important that the definition be very perfect. The quarter-plate lens with which they are often taken, is rarely equal to the task, the reason being that the field has too much curvature, and the definition is seldom sufficiently good on the edges of the field. Hence, many a lens that takes a good quarter-plate sitting picture where the head is near the centre of the plate, fails to give a well-defined card-portrait where the head and feet are placed at the edges of the field. This roundness of field is often advantageous in ordinary sitting pictures; but in the small full-lengths it is objectionable. It is very annoying in focussing on the hands to find the head and feet indistinct, and, on turning the lens to make the latter sharp, to find the former all blurred.

A lens, though possessing a curved field, if it give good definition on the edge of the field, may, by the use of Waterhouse diaphragms, be fitted for taking these pictures by employing a stop that causes the head, feet, and hands to be in focus at the same time.

When the glass room is long enough, a half-plate lens is the proper one to use, and much less distortion, more natural proportion, and more equable definition will then be obtained.

In taking these pictures, it is important that the lens and

camera should be kept horizontal, and pointed nearly opposite the centre of the figure. Unless this be attended to, especially with short-focus lenses, the individual will be represented as if standing on an inclined plane, instead of a solid floor; the lower part of the legs and feet will also be considerably distorted and out of focus.

These pictures require a special arrangement of light. They will bear a little stronger distribution of light and shadow than ordinary photographs, for as all the features are so small, it is important they be well marked. Sufficient diffused light must, however, be used to soften the shadows, and prevent the pictures being hard in outline and black and white in tone.

The collodion used should be such that gives transparent shadows; the bath should be slightly acid, and the developer should have sufficient acid to keep the deep shadows free from deposit. All the chemicals, in fact, should be in such condition as to give clear, clean, and brilliant negatives.

It is usual to employ a camera with two or four lenses mounted on it, and thus to take two or four pictures with one exposure, and, by means of a repeating movement in the dark slide of the camera, double the number may be taken on one plate.

In all other respects the production of these pictures is the same as the usual photographs, except that as they are so much improved by the final rolling process, that operation should never be omitted.

DIAPHRAGMS OR "STOPS" IN LENSES.

DIAPHRAGMS or stops are discs of metal or card-board with circular apertures placed before or between the lenses.

Their use is to produce clearer and more distinct definition,

especially on the margin of the picture ; also to cause near and distant objects to be in focus at the same time. In single, or Landscape lenses, they are placed some distance in front ; and in double combination, or Portrait lenses, they are placed either in contact with the front surface of the anterior lens, or midway between the lenses. Their purpose is always the same, to cause increased "sharpness;" for, *the smaller the diaphragm, the more perfect the definition and the greater the depth of focus* ; and also the longer the time required for exposure.

The old-fashioned mode of placing the diaphragms in a portrait lens, immediately in front, is much inferior to the more recent method of placing them between the lenses. There are several methods of doing this, but the most ingenious is that introduced by Mr. Waterhouse, of inserting the diaphragms through a slit in the lens-tube.

This plan is so very simple and effective, for the stops can be instantly changed without touching the lenses or disturbing the focus, that no portrait lens should be considered complete unless so furnished. Old lenses can readily be altered and have these improved diaphragms put to them without disturbing the glasses.

As many young photographers, and some older ones, do not sufficiently appreciate the value of diaphragms, a few words on their use may be in place.

Landscape lenses, from their nature, require to be used with small stops. They must always be placed in advance of the lens ; and though there is no absolute point for their position, the optician places them at such a safe working distance as will suit the majority of purposes.

Portrait lenses are supposed to be sufficiently perfect to be worked without stops. This is a mistake ; for, in

consequence of all the definition being on one plane, and that a curved one, it is impossible to get complete sharpness all over a flat glass, and more especially when the lens is but a few feet distant from the sitter.

As a regular practice no portrait lens, unless it be of very long focus, should be used with open aperture ; but the smallest sized diaphragm, that the circumstances will allow, should be employed. The open aperture should be considered as a reserve of force, to be used only when other means fail, and is only legitimately applicable to young children, very nervous persons, palsied subjects, moving objects, &c. It is excusable in wintry weather to use short focus lenses and open aperture ; but it should never be forgotten, that what is gained in time is lost in definition, and that during the other three parts of the year, only a few seconds longer exposure with the use of a diaphragm, makes the difference between a picture being sharp nearly all over, and one where a spot or two only is in focus, and the rest woolly and indistinct.

There is a certain desirable and harmonious distinctness that should be distributed over every picture, the most important parts, and those nearest to the eye, being the best defined, and receding objects, or parts of objects, losing their distinctness as they retire. Microscopic sharpness, and general haziness, are equally undesirable ; the happy medium to be aimed at being that natural blending of softness and sharpness that characterise the works of the best artists, and which can only be secured by the liberal use of diaphragms and the exercise of good taste.

HOW TO ARRANGE THE LENSES IN A PORTRAIT COMBINATION.

THE lenses in a portrait combination are occasionally removed

from their cells for the purpose of cleaning. Generally speaking, it is sufficient to unscrew the mountings and wipe with chamois leather the two surfaces exposed. They can then be easily replaced; for the brass fittings are usually so made that if by mistake the cells are screwed into the wrong places, the hood, or projecting shade will not go on. The mistake is, therefore, easily detected and corrected. When, however, the lenses themselves are taken out of their cells—and, except for curiosity, this is rarely required, for the inner surfaces do not become dirty like the outer ones—the case is very different, for they may be variously transposed, and thus rendered incapable of producing good pictures. There is risk also of breaking one of the glasses of the back lens in screwing it in, unless it be put together in the proper manner. Many good lenses have been condemned as hopelessly bad through being thus transposed.

In a portrait combination there are four lenses in all; the so-called *front* and *back* lenses being really each formed of a pair. The front ones are always cemented together, and may thus be easily taken for one lens; the back pair are distinct, and are usually separated from each other by a narrow ring.

To place them in their proper positions, proceed as follows:—take the front lens—the pair cemented together—and observe that one surface is considerably curved, and the other almost flat; place the lens in its cell so that when screwed into the tube, the curved side will be to the sitter. The two glasses forming the back lens are very unlike each other; one is thick in the centre and thin at the edge, the other, thick at the edge and thin at the centre; put the thin-edged one first into the cell resting on the least curved side, next put in the ring, and then the thick-edged glass, concave

side towards the other lens; fix them in their places with the part provided, and screw the cell in its place.

With many portrait lenses there is an arrangement whereby the front lens may be used as a landscape lens; when thus employed, the *flat* surface must be presented to the object.

ON THE MULTIPLICATION OF NEGATIVES.

It is often desirable to multiply a valuable negative. There are several methods of doing this depending on the question of size. To obtain a duplicate negative the same size as the original, prepare a plate by any of the dry processes already described. Place the negative and dry plate in contact in a printing frame, as in the ordinary printing process, and expose the frame to diffused daylight for a second or two, then develop the plate and a transparent positive will be obtained. Fix and varnish this in the usual manner, and use it with another dry plate in a similar way, and thus a duplicate negative is obtained. The transparent positive can be used to obtain an indefinite number of negatives. It should be very clear and distinct, and not very intense.

When the duplicate negative is required larger or smaller than the original, the operation must be different. Secure a room that has a window looking to the north sky. Place a shutter over this window and cut a hole just large enough to admit the negative. Place the camera in this room opposite the negative, and adjust by moving it backwards or forwards, until the image on the ground glass is of the size you desire. No other light must be in the room but that that comes through the negative. Take a picture now by the usual wet process, and you have a transparent positive. Put this transparent positive in the same aperture in the shutter and

proceed as before, and you will obtain a negative, and thus you can produce an indefinite number. If the above operations are cleverly managed, the resulting negatives, even though considerably enlarged, will have all the characteristics of being taken direct from life, and will be far superior to the best that can be obtained by copying from paper prints. Thin negatives with abundance of detail are those that copy best.

ON COPYING, AND THE PROPER LENSES TO BE USED.

THOUGH portraits and views engage the principal attention of photographers, yet copying prints, drawings, paintings, &c., is a very interesting branch. Pictures may be copied of same dimensions, or of larger or smaller sizes than themselves. To obtain a reduced copy of an engraving, for example, is very easy. The glass must be removed, the picture placed in a good light, and arranged vertically and exactly square with the front of the camera. The latter should be quite level, with the lens directed exactly to the centre of the print.

A diaphragm must be placed in the lens sufficiently small to cause the definition to be equally good on the edges and in the centre.

Generally speaking, landscape lenses are best adapted, but portrait lenses with small diaphragms will answer when the copies are not of large dimension.

When a drawing is required to be reproduced the same size as itself, the difficulties are greater. It will be desirable to use either a large portrait lens with a small stop in the centre, or a long focus single lens, and use only one-half or two-thirds of the field it is supposed to cover. Unless these precautions be taken, if the picture be any size, the mar-

ginal lines, instead of being straight, will be bent barrel-shaped.

The orthoscopic lens was intended to correct this error, but its fault is of the opposite kind, a tendency to curve the lines inward, hour-glass shaped.

Where absolute accuracy is desired, Mr. Dallmeyer's triplet or Harrison's globe lens should be used, as they render vertical lines neither barrel nor hour-glass shaped, but literally straight.

HOW TO CONSTRUCT A COPYING AND ENLARGING CAMERA.

Pictures are sometimes required to be copied of an enlarged size. Small portraits, three or four inches square, enlarged to 10 by 8, or 12 by 10 inches, are the most usual examples. For this work a *copying camera* is required, that is, one with a long-expanding body, which should be of leather, accordion-fashion, so that it may be used at various distances.

The size of this camera will be determined in its width and height by the dimensions of the largest plates proposed to be used, and in its length by the focal length of the enlarging lens, and the number of times the copies are to be magnified.

Let a case be supposed: it is required to enlarge a picture on a $2\frac{1}{2}$ by 2-inch plate to fill a 10 by 8-inch one. For this work a good quarter-plate lens provided with Waterhouse diaphragms will answer. The equivalent focus of these lenses is usually about six inches. The enlargement required in the present instance is four times, linear measure. The distance the ground-glass should be from the back lens must be calculated to know the length of the camera required.

The rule that determines this is simple and easy to be remembered: *multiply the focal length of the lens to be used by the number of times of enlargement, and add the focal length to the product.* Thus the picture is to be enlarged four times, the focal length of the lens is six inches, four times six are twenty-four; now add the focal length—six inches—and thirty inches is the distance for the ground-glass to be behind the lens; therefore, a camera that will expand to three feet will be ample. The distance for the picture to be placed in front of the lens is always more than the focal length and less than twice the focal length; in this instance it will be $7\frac{1}{2}$ inches.

If a different lens were employed, say a Dallmeyer's No. 1 triplet—an excellent one for copying and enlarging—the equivalent focus of which is nearly eight inches, a camera to do the above work would require to be 10 inches longer; but if a whole-plate lens with about 12-inch equivalent focus were used, the camera would have to be 5 feet long. The above examples will show that the focal length of the lens and the number of times of enlargement of the copy determine the length of the copying camera.

TABLE OF ENLARGEMENT AND REDUCTION;

GIVING THE DISTANCES BETWEEN THE LENS AND THE OBJECT, AND THE LENS AND THE FOCUSING GLASS, FOR ENLARGING OR REDUCING FROM THE SAME SIZE TO TEN TIMES THE SIZE OF THE ORIGINAL.

FOCUS OF LENS.		NUMBER OF TIMES OF ENLARGEMENT OR REDUCTION.									
		Same Size.	2	3	4	5	6	7	8	9	10
Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
4	8 × 8	12 × 6	16 × 5½	20 × 5	24 × 4½	28 × 4⅔	32 × 4¼	36 × 4½	40 × 4¼	44 × 4⅔	48 × 4½
4½	9 × 9	13½ × 6¾	18 × 6	22½ × 5⅝	27 × 5⅔	31½ × 5¼	36 × 5¼	40½ × 5⅛	45 × 5	49½ × 4⅝	54 × 4½
5	10 × 10	15 × 7½	20 × 6⅔	25 × 6¼	30 × 6	35 × 5⅝	40 × 5⅝	45 × 5⅝	50 × 5⅝	55 × 5½	60 × 5½
6	12 × 12	18 × 9	24 × 8	30 × 7½	36 × 7½	42 × 7	48 × 6¾	54 × 6¾	60 × 6⅔	66 × 6⅔	72 × 6⅔
7	14 × 14	21 × 10½	28 × 9½	35 × 8¾	42 × 8⅔	49 × 8⅞	56 × 8	63 × 7⅞	70 × 7⅞	77 × 7⅞	84 × 7⅞
8	16 × 16	24 × 12	32 × 10⅔	40 × 10	48 × 9⅔	56 × 9½	64 × 9¼	72 × 9	80 × 8⅝	88 × 8⅝	96 × 8⅝
9	18 × 18	27 × 13½	36 × 12	45 × 11¼	54 × 10¼	63 × 10½	72 × 10⅓	81 × 10⅓	90 × 10	99 × 9⅝	108 × 9⅝
10	20 × 20	30 × 15	40 × 13½	50 × 12½	60 × 12	70 × 11⅔	80 × 11⅓	90 × 11⅓	100 × 11⅓	110 × 11	120 × 11

This table shows at a glance the distance the object must be in front of the lens, and the distance the ground glass must be behind, for reducing or enlarging from the same, to ten times the original size of the object.

The calculations are for lenses from 4 to 10 inches focal length.

For enlarging, the figures on the left side of the \times give the distance from the lens to the ground glass, and the figures on the right side give the distance in front of the lens: for reducing, exactly the reverse rule applies. If the \times be taken to represent the lens, the figures on each side will show how far before the lens the object must be put, and how far the ground glass must be placed behind the lens, according to the focal length of the lens employed, and the degree of enlargement required.

For single lenses the distances may be measured from the lens itself, and in Dallmeyer's triplets it may be taken from the diaphragm slot. An exact rule cannot be given for double combinations where the equivalent length of focus is unknown, but for practical use the point may be measured from the Waterhouse diaphragms, or if they are not provided, from midway between the inner surfaces of the front and back lenses.

To use the table: suppose a picture has to be copied three times larger with a lens of 5-inch equivalent focus, and it is required to know how much the camera must be drawn out. By referring to the side column, "focus of lens," select 5, and on the horizontal line 3 will be seen $20 \times 6\frac{2}{3}$. The camera must be lengthened for the ground glass to be 20 inches from the lens, or the part measured from, and the object must be $6\frac{2}{3}$ in advance of the same point. If the lens were 8-inch focus, the table shows that the picture must be $10\frac{2}{3}$ inches in front,

and the ground glass 32 inches behind the lens, and so on for various focal lengths and different degrees of enlargement.

THE SOLAR CAMERA, AND HOW TO PRODUCE LIFE-SIZE PICTURES.

By the method of copying already described, pictures can be obtained considerably enlarged, and with a satisfactory degree of definition; but a bound is soon reached in consequence of the weakness of the light when distributed over a large surface. To meet this difficulty, the Solar Camera has been invented by an American gentleman, Mr. Woodward, which supplies the means of illumination in so superior a degree that a new impetus has been given to the production of pictures by enlargement.

The instrument is based on the principle of the solar microscope, and is intended to be used in direct sunshine. It consists of a large strong box, some 11 inches square, with sliding adjustments, like an ordinary camera. The front has adaptations for various lenses, but an ordinary $\frac{1}{2}$ -plate portrait lens is the one usually employed. Inside of the camera, and near the back, is placed a large plano-convex condensing lens, 9 inches in diameter, 17 inches focus, with the plane side inwards. Firmly attached to the camera back is a glass mirror, about two feet long, and nearly a foot broad. The picture to be enlarged is placed in a moveable partition between the condenser and the portrait lens.

To use this instrument, a room with a south aspect is selected. A strong table or bench is placed under the window to support the camera. The camera is placed with its back close to the window, all the light from which should be stopped out, except about a square foot, through which the mirror

should pass, and a small portion of it which is made yellow to see to work by. A few feet from the camera is placed a screen on which is received the enlarged image, magic-lantern fashion. This dark chamber becomes, in fact, a huge camera, in which the operator conducts all his operations. The picture to be copied must be a weak glass negative, or over-exposed positive, with abundance of detail in the shadows and not too dense in the high lights. An ordinary negative will not produce good pictures, being too opaque.

The picture should be very clear, clean, and sharp; it should not be varnished. Any size under a whole-plate may be copied, but a 5×4 or $1\frac{1}{2}$ plate is best. A sun-shiny day must be selected, and the mirror so turned that it catches the solar rays and reflects them on the condensing lens. The size of the picture to be produced is determined by the distance the receiving screen is placed from the portrait lens; the further it is removed, the greater the enlargement. The apparatus must be so adjusted that, when the picture is exactly in focus, the solar spark produced by the condensing lens must be precisely in the centre of the front surface of the portrait lens. By means of rack-work attached, the mirror can be moved in any direction to follow the motion of the sun. These movements can be made *inside* the room, which is a great convenience. Pictures may be obtained without the sun, but they are much superior with it, for one of the advantages of the instrument consists in the mass of light that is collected and concentrated on the negative, hence a greatly enlarged, yet brilliantly illuminated, image can be obtained. A picture can be directly printed on albumenized paper in from one to three hours; but the mode generally adopted is to use a "development" process as described on page 32. A few seconds exposure is then sufficient. The developing is

conducted as there described, and with moderately careful management, pictures can be produced much better in brilliancy, sharpness, rapidity, and delicacy, than by any other enlarging means. So far as *size* is concerned, the operator is bounded only by the troubles of manipulation and *materiel*, otherwise there would be no difficulty in enlarging portraits to colossal proportions, and increasing half-plate pictures to ten feet dimensions. It is not to be supposed that the same degree of delicacy of definition is retained when this great enlargement is attempted, but the general truthfulness of effect and absence of distortion is really remarkable.

TRANSPARENCIES FOR THE MAGIC LANTERN.

A VERY interesting application of photography is the production of magic-lantern transparencies. They may be produced by the dry or the wet processes. The first proceeding is to obtain a suitable negative. It should be clear, clean, and very sharp. The high lights should not be too opaque, but full of half-tone, and the shadows free from fog and full of detail. There ought to be an entire freedom from all smears, markings, stains, spots, and comets. Although there is no fixed size for the magic lantern, yet $3\frac{1}{4}$ inches square is a usual size, and for which the ordinary stereoscopic negative is well adapted, but every person will, of course, make the pictures the dimension to suit his own lantern. If the negative be the same size that the transparency is wished, the proceeding is very simple, as any of the dry processes may be employed—the tannin by preference, in consequence of the rich tone it gives. The negative has to be placed in the printing frame, and the dry plate put in contact, as in

ordinary printing. A few seconds exposure in diffused light, varying with the intensity of the negative, will be enough. Or gaslight may be used, when a few minutes will be necessary. The plates must be developed according to the directions given for each process. If gallic acid be used, the resulting picture will be a greenish-black tone; pyrogallie and citric acid yield a bluish-black, and pyrogallie and acetic acid a brown-black tone. The tannin process gives a rich chesnut brown that is much admired. The picture, when finished, should not be varnished, unless the blacks are foggy, but mounted by putting another glass the same size to protect the collodion film, and binding the edges like a *passe partout*.

If, however, the negative from which the transparency is to be made is larger or smaller than the size required for the lantern, the lens and camera must be employed, and the negative must be copied *by transparency*. Many methods of doing this will suggest themselves to ingenious persons, but the neatest is by the use of a "copying camera for transparencies." This instrument is a kind of double bellows-bodied camera; that is, another body is provided *before* the lens, in addition to the usual body behind it. This extra body is provided with sliding holders to receive different sized negatives. The screen carrying the lens can be freely moved backwards or forwards, so as to approach either the negative or the ground glass, so that either a reduced or enlarged copy may be made. To use the camera, place the negative in its holder at one end and the usual ground glass in the other, screw the lens on to the central screen and put it in its place. If the copy is required to be exactly the size of the original, place the negative twice the focal length in advance of the lens and the ground glass the same distance behind. If the size is to be

reduced, push the negative further from the lens and put the ground glass nearer ; if it is to be increased, reverse the plan, putting the negative nearer and the ground glass further from the lens. How much nearer or how much further the lens must be from the ground glass or the negative, depends on the focal length of the lens, and on the desired degree of enlargement or reduction. This point may, however, be remembered that neither the ground glass nor the negative must be put so near to the lens as its focal length, or no image will be formed.

The adjustment made, the camera may be inclined to the north sky, and the lightstreaming through the negative will form its image on the ground glass in the usual manner. A quarter-plate double combination lens, with central diaphragms, will be found very convenient for this work. First focus with open aperture, then put in the smallest stop, and proceed as if for producing an ordinary negative ; but instead of a negative a transparent positive will be produced. The tannin process has already been noticed as serviceable for this work, but any other may be employed. Most usually the ordinary wet method will be found the easiest and simplest. Pyrogallie acid or iron may be used as a developer, the former by preference, as yielding a better tone and denser image. If the latter be used and the tone be not approved, intensify after fixing, with pyro 2 grains, citric acid 1 grain, water 1 ounce. Or, to produce blacker tones, wash the plate well from the hypo or cyanide fixing solutions, and pour on a saturated aqueous solution of bichloride of mercury, until a grey appearance appears on the plate, then wash well, and apply solution of iodide of potassium, 2 grains to 1 ounce of water, which produces a greenish grey image ; wash well, and finish with a

solution of ammonia 1 drachm, water 1 ounce, which will change the image to a black colour. If the first deposit from the developer was not very dense, these operations may be repeated; the densest blacks may be obtained by these means.

It has already been stated that the pictures for the lantern need not be varnished. If, however, varnish be used, crystal varnish, drying without heat, will be found better than a thick spirit varnish, which would probably show markings when magnified on the screen. If the picture, on drying, be found too opaque, varnish will be found to restore transparency.

CLEANING AND RESTORING DAGUERREOTYPES.

THESE pictures frequently become obscured with a bluish film, and the picture is then said to be faded or "gone." This is a mistake, for with a little pains they can be made as perfect as ever. Carefully remove the mat and glass, paying special attention not to touch the face of the plate in this or any of the after operations, for the least touch will leave a mark that can never be removed. If any gum paper adhere at the back, moisten and remove it. Hold the plate face upwards, resting it on the tips of the fingers, and allow water from the tap to flow over it, then pour over its surface a freshly made solution of cyanide of potassium, about five grains to the ounce. Let the cyanide flow backwards and forwards till the discoloured film is dissolved off. Sometimes an obstinate patch will remain after the rest of the plate is clean; pour the cyanide off and on at this place, as if developing, and it will disappear.

Be careful not to use the cyanide too strong, or the picture itself will be dissolved away. It is better to employ quite a weak solution and take a little more time than run a risk of

injuring the picture. Sometimes a solution of hypo—which never injures the plate—or even plain water is sufficient to remove the obscuring film. If these means fail, cyanide will always be found successful. When the stain is all dissolved, wash the cyanide away, finishing with a swill of distilled water, and dry the plate over a spirit lamp. The plate must not be allowed to dry spontaneously like a glass one, but must be finished off at once with direct heat. A pair of pliers should be used to hold the plate while drying, and the water should be made to evaporate from the upper corner downwards in one steady, uniform wave, otherwise stains will occur. It will be impossible to dry the plate off clearly unless the last wash is with distilled water, as common water on evaporation precipitates its impurities on the plate.

If the above precautions be taken, the daguerreotype may be restored to all its original beauty, for these are the only examples of photography that never fade.

INSTANTANEOUS PHOTOGRAPHY.

ALTHOUGH the usual collodion process is very rapid, yet the highest degree of sensibility is required to delineate moving objects. Instantaneous photography therefore becomes a necessity. It can only be accomplished, however, under the most favourable circumstances, and by the most careful attention to certain conditions. The term “instantaneous” is not very exact; with different persons it may mean a minute, a second, or the smallest fraction of a second, but practically it can only be that small interval of time between the most rapid uncovering and covering of a lens. If with this short exposure objects in motion are represented as clear and distinct as if they had not been moving, then the operation is perfect.

To secure this desirable rapidity, it is necessary, in the present state of our knowledge, to have everything in its most favourable condition; thus the light must be very pure and strong, the objects well illuminated, the lens very powerful, the collodion extremely sensitive, the bath in best order, the developer rapid, and the plate not large in size. With these conditions, photographs may be produced as quickly as the lenses can be uncovered and covered. It will be perceived, then, that instantaneous photography depends upon a happy conjunction of rare conditions. The absurdity, therefore, of speaking of instantaneous lenses or collodions or developers is very evident, seeing that the rapid action depends, not on *one*, but on *all* simultaneously performing their parts well.

A few words on each of these agencies, pointing out the most favourable conditions for rapidity in each, will not be out of place.

The Light.—During the later spring, and early summer months, the light possesses more actinism than during the other parts of the year. In the open country the action is more rapid, of course, than in towns, but on the sea-coast it reaches its maximum powers. This observation has been made by so many careful observers, that it may be considered established. Generally speaking, the light is more actinic during the early hours of the day; but this is modified by the accidental position of objects in relation to the course of the sun.

Atmospheric conditions considerably modify actinism. Light fleecy clouds are more favourable than a clear blue sky. Sometimes the light is very strong when the whole atmosphere is grey with rain-clouds, and in the intervals between April showers it often exhibits wonderful energy.

East and north-east winds have great influence in retarding photographic action. Frosty weather is favourable, and snow storms are hostile to it; but the greatest enemy of all is a yellow fog.

Lenses.—To produce rapid pictures, good lenses must be obtained. The most favourable condition for a lens to work quickly, is to have a large diameter, and a short focus. The size of its diameter determines the volume of light to be admitted, and the length of focus fixes the amount of space it will cover; and, consequently, as light works quicker, the more it is concentrated, *the widest possible diameter, and shortest possible focus, form the extreme degree of quick-acting power in any lens.*

Of two lenses, equal in other respects, that one is the quickest that has the largest diameter; and also of two lenses, otherwise equal, that one is the most rapid that has the shortest focus.

It should be understood that although extreme width of diameter, and shortness of focus, are the best conditions for quick-acting lenses, they are not the most favourable for general definition, and, therefore, not so fitted for ordinary use.

With single or landscape lenses, the use of moderately small stops is indispensable to secure passable definition. For quick work, double-combination, or portrait lenses should be used, as they may be employed with much larger diaphragms, and yet give passably good definition, but Waterhouse stops should always be provided.

The Chemicals.—The collodion best adapted for instantaneous work is the extra bromo-iodized. It should form a good rich film in the bath, and, with the proper exposure, be capable of giving a rather dense image with the iron developer

alone. It should be iodized some time before using, for newly sensitized collodion of this kind is apt to yield thin, foggy pictures.

The nitrate bath should be formed of pure nitrate of silver, 35 or 40 grains per ounce; it should be only sufficiently acid to keep the shadows clear. The following developer is very well suited for rapid work :—

Proto-sulphate of iron	...	...	1 ounce.
Glacial acetic acid	...	...	$\frac{1}{2}$ ounce.
Alcohol	...	...	<i>quant. suff.</i>
Water	...	...	10 ounces.

This developer should remain on the plate sufficiently long to bring out all the details, and also to give as much density as can be obtained by the iron alone. Of course a sufficiently dense negative will not be expected; but the denser the original deposit, the more easy will be the after intensifying; for full particulars of which, see chapter on Intensifying Processes.

The method given above comprises the quickest means known of producing photographs, and is the plan adopted by the most successful operators in this difficult branch.

STEREOSCOPIC PICTURES.

THE principle of stereoscopic pictures depends on the production of two pictures taken of the same object at slightly different points of view. Two cameras may be used, each provided with its own plate, or the same camera may be used twice, by moving it slightly on one side to obtain the necessary difference in the point of view. If the difference between the two points of view be considerable the effect in the

stereoscope will be that of exaggerated relief and distortion. Under all ordinary circumstances the best effect is produced by the use of the binocular camera, as the two lenses are then employed in the simplest and readiest manner, and the pictures produced have the relief of nature. It is also a great convenience to have both pictures on one glass, as one preparing of the plate serves for each. As the two pictures are exposed simultaneously the same objects will be in each, whereas when they are exposed at different intervals of time, only still life objects can be produced with certainty. The binocular camera is therefore recommended. In selecting the points of view, particularly in landscapes, it is especially desirable to have some objects in the foreground, otherwise the picture when seen in the stereoscope will be tame and flat. Sometimes a post, an old tree, even a few twigs will be sufficient, but it is of the highest importance that some object should be there, so as definitely to mark the foreground and then all other objects will fall into their relative planes, and communicate the sense of relief.

When the binocular camera is used, the pictures after being printed must be cut and transposed, so that the right hand one shall be placed on the left, and *vice versâ*. When many copies are wanted, it is better to cut the negative itself, transposing the two halves, and then glue them by the corners to another glass, and thus the paper prints will be printed right at once.

In producing Stereo Negatives a rather different treatment is required than for other pictures. It is not so much a brilliant picture, that may look well out of the stereoscope, that is wanted, as a soft and delicate one that looks well in the instrument. In particular there must be no masses of hard white light, or patches of deep black shadows without

detail. The negative must be exposed sufficiently long in the camera to bring out all the details in the deepest shades ; and in developing, the intensifying must not be carried so far as to fill up any of the details in the high lights. By these means a picture will be produced which, though somewhat lacking in brilliancy out of the stereoscope, will amply repay, by the beauty of its details, when seen in it.

COLOURING PHOTOGRAPHS.

Portraits on paper are coloured in oil, water-colour, or by crayons. Crayon or chalk is principally adapted for the very large sizes where boldness and breadth are required ; water-colour suits small subjects where great delicacy and minute finish are necessary, such as locketts, brooches, and miniature work generally ; and oil colouring fills up the intermediate portion, in which is included the great bulk of portraits. In the early days nearly all the pictures were finished in water-colour ; oil painting has, however, gained the ascendancy from its superior boldness and vigour, and from its supposed greater stability. Colouring in oil admits of great variety, from the solid substantiality of the old-fashioned family portrait, to the almost miniature-like delicacy of ivory paintings.

It is beyond the scope of the present work to go into this subject, and the reader is referred to a very useful and well-written manual — “*Harmonious Colouring*,” published by Newman — in which the subject is ably treated. It is brimful of information, and cannot be perused but with profit by both artist and photographer. For the complete treatment of the subject, however, the reader is referred to the “*Manual of Photographic Colouring*,” published by Piper, Paternoster

Row, and written by Mr. Alfred Wall, a gentleman whose practical skill and many contributions to artistic and photographic literature render his work a standard one. The volume is replete with general and technical information upon every description of photographic colouring.

HOW TO RECOVER GOLD AND SILVER FROM WASTE PHOTOGRAPHIC MATERIALS.

As much of the valuable metals used in photography is not really consumed, many methods have been devised to recover them. Where only a small quantity accumulates it may be sent to the refiners, but where the quantity is great it will be worth the photographer's while to reduce it himself. There are different ways to accomplish this, but as the subject has been so lucidly described by Mr. England, in a paper read before the London Photographic Society, it will be best to use his words :—

“The materials to be operated upon are too well known to need description. They may, therefore, be taken in the following order :—

“Firstly, Washings from the prints and all solutions that can be precipitated as chlorides.

“Secondly, Hypo fixing baths, to which may be added the used-out toning bath, &c.

“Thirdly, Sensitive-paper cuttings, filters, and any materials containing silver which can be reduced to ashes; and,

“Lastly, Kaolin, which has been used for cleansing the sensitizing bath. This contains a large amount of nitrate.

“I shall, in the first part of this paper, speak of some of the methods of precipitating and preparing the sulphurets, chlorides, &c., ready for the furnace; and, in the second, the reduction of the same into the metallic state.

"The first on our list are the chlorides. The method of precipitation with common salt is so well-known that no mention is required, more than that the deposit should be well washed and thoroughly dried.

"In recovering the metals from the hypo solutions, Mr. Hardwich recommends that it should be boiled for two or three hours in contact with zinc; other authorities recommend adding to the boiling solution hydrochloric acid. Neither of these methods is found in practice to answer well. With the first it is difficult to get rid of the whole of the zinc; and the second plan is objectionable on account of the large amount of sulphur precipitated with the silver, and which gives considerable trouble in the process of reduction. Perhaps there is no better method than the one most commonly adopted, that of adding sulphide of potassium; but care should be taken not to add an excess. A simple way to avoid waste is to test as follows:—After the deposit has subsided, test the liquor in a test-tube by dropping in a drop or two of sulphide solution; the result will show at a glance whether the whole of the silver and gold has been thrown down.

"Now, take another sample and test with silver, to ascertain if an excess of silver has been added; if so, it would be advisable to throw in more of the fixing bath, and allow it to settle before drawing off. These experiments are necessary; for, if sufficient sulphide has not been used, of course the whole of the silver will not be precipitated; and should a large excess have been thrown in, a portion of the deposit would be re-dissolved, causing a waste.

"The silvered paper may be conveniently burnt out in the open air in a sheet-iron box about three feet deep by two wide. Allow the burnt waste to smoulder for a considerable time, to burn off the charred matter; by so doing, it will take

up less space in the crucible in reducing. It is a curious fact, that these burnt ashes are very sensitive to light, changing from a light drab to a deep brown in a few minutes in sunshine, proving that the action of the fire in consuming the paper only fuses the chloride, instead of reducing it to metallic particles.

“Kaolin, as may be supposed, cannot be readily melted in the furnace; therefore, in operating upon this material, we must proceed in a different manner. A simple and economical method is to place a pound or two in a stone pitcher, and pour in an equal quantity of nitric acid, containing about 25 per cent. of water, stirring well the while. Place the pitcher in a warm place for a few hours, and afterwards add a couple of quarts of water, stirring it well again. Allow the kaolin to settle, and draw off, repeating the operation several times, of course saving the liquid, from which the silver can be precipitated as chloride. Kaolin, treated in this way, may be used any number of times, provided the acid is well washed out.

“I will now proceed to the second part of this paper—the reduction of the metals. A good furnace is, of course, indispensable. Black’s answers very well; but it is too small to take a good-sized crucible. A furnace may be constructed of a simple form and very cheap with a few fire-bricks. A convenient size is about two feet deep by sixteen inches wide, with an ash-pit beneath. No door will be required, as it may be fed from the top. Half a dozen bricks, cemented together and bound round with an iron band, will form an excellent cover. This furnace should be built where a good draught can be obtained, as the success of our operations will much depend upon having a considerable heat. The only other apparatus required is a few crucibles, usually

called pots, a pair of long pincers, some fluxes, such as borax, carbonate of soda, carbonate of potash, and some nitre.

“Now let us suppose everything ready to commence operations.

“We will begin with the ashes from the paper, that being the simplest. Weigh out two 2 lbs. of ashes, to which add the same quantity of carbonate of soda and 1 lb. of carbonate of potash. Afterwards take a well dried crucible, and place it in the furnace, mouth downwards, and build up the fire around it. It is necessary to adopt this plan to prevent the pot splitting: or when, in our innocence, we fondly imagine our smelting operations to be complete, on looking in the pot, we discover, not metal, but emptiness, and the silver in the ashes under the furnace. After the fire has burnt up, take out the crucible and place it in the right position, mouth upwards. Now fill it about three parts full with the mixture; again make up the fire to a good heat. After the contents of the pot have melted down, another lot may be added, again making up the fire to the greatest possible degree of heat, and in about an hour our operation will be complete, provided the fire has been properly attended to.

“To economise time and material, the pot may be taken from the fire, and the contents poured into an iron ladle, the pot put back into the furnace, again filled up with more material, proceeding as before. On turning out the contents of the ladle, the silver will be found at the bottom of the flux.

“In reducing chloride, a different method must be adopted. Mix carbonate of soda and potash in equal quantities, add one pound to one pound of chloride of silver, mix well, and throw into a red-hot crucible small portions at a time; for, if the whole were thrown in at once, the effervescence which

ensues would boil over, and cause a considerable waste of silver. It is necessary in these operations to weigh out the materials, and after each one to compare results, to enable us to judge whether our experiment has been complete.

"Chloride of silver will yield 75 per cent. of metal, paper ashes about 50 to 60 per cent.; but, of course, much will depend upon its freedom from impurities.

"Sulphuret of silver and gold is much more difficult to reduce, on account of the large amount of sulphur in combination. After the precipitate has been thoroughly dried, it must be mixed with an equal weight of nitre, and thrown a little at a time into a red-hot crucible. An iron ladle will be necessary for this purpose. Care must be taken not to put in too large a quantity, or the combustion which takes place will drive the metal out of the pot. When the crucible is full, the fire must be made up, and a good heat maintained for about half an hour, after which the cover may be removed, and a portion of the flux taken out with an iron ladle, to make room for more material, and the same process repeated; after which more flux should be taken out and its place supplied with a small quantity of nitre, and some carbonate of soda. This will ensure the whole of the sulphur being got rid of. The fire should now be continued for about a couple of hours.

"On removing the crucible from the fire, should the experiment have been successful, the whole of the silver, in combination with the gold, will be found at the bottom of the pot.

"The two metals may be readily separated by nitric acid, to which a little water has been added to assist the oxidation. The gold will be left in the state of a fine black powder, which must be carefully separated, and may be converted into chloride by nitro-muriatic in the usual way."

REMOVING SILVER STAINS FROM THE HANDS.

RECENT stains on the hands are more easily removed than old ones. On the same day they are made they may be easily taken away. Wash the hands well in soap and water, and get off the adherent metallic silver with a nail brush, then rub the stain with a flat piece of pumice stone; if the skin be not too tender, the greater part of the stain may thus be removed. Finish with a piece of cyanide of potassium, and, with the hand still wet, rub the part gently with it, and the stain will disappear.

Older stains are not so easily moved. It is a good plan to use all available mechanical means before having recourse to chemical ones to remove the stains; hence, the hands should be well washed in warm water with plenty of soap. This softens the hard skin; next use the pumice stone, and with friction remove the mark as much as possible without making the skin smart. Take a crystal of iodide of potassium, and, just dipped in water, rub in on the mark till it changes it to a yellow patch, wash, and use the cyanide till it disappears.

Another method is to keep a saturated solution of cyanide of potassium in one bottle, and a solution, ten grains to the ounce, of iodide of potassium, to which has been added as much iodine as it will dissolve. Touch the stain first with the iodide solution, wash, and then use the cyanide, rubbing it on the yellow stains. The skin on the back and sides of the hands is more delicate than on the inside, and will not bear much friction.

The stain on the hands, if left alone, generally disappears in about a week. The nails are more difficult to clean;

scraping with a penknife, after the rest of the hands have been cleaned, is the best proceeding.

Cyanide must never be used to the hands when the skin is cut, scratched, or in any manner injured, as not only immediate pain, but ultimate danger may result from the absorption of the poison.

REMOVING SILVER STAINS FROM LINEN.

Stains should always be removed from linen before it is sent to be washed and ironed. The heat from the ironing tends to make them more indelible, and always renders the removal more difficult. Wet the part stained, and put on a few drops of a saturated solution of cyanide, or rub it with a solid lump; if the mark does not quickly disappear, wash, and put on a drop or two of the iodine solution mentioned in the preceding paragraph; the stain will now quickly change colour, and a little cyanide will easily dissolve it. When the linen is double, and the stain goes through, the solutions must be applied each side.

REMOVING YELLOW IRON STAINS FROM LINEN.

Sometimes operators' wristbands are as much stained by the iron as by the silver solutions. Yellow stains, commonly called iron-mould, are easily removed by hydrochloric acid, or hot solution of oxalic acid, washing well in warm water afterwards.

INTENSIFYING PROCESSES.

WHEN a negative is developed by pyrogallie acid, abundance of intensity is easily obtained; indeed, the usual fault is that the pictures are too intense, and, in consequence,

deficient in half-tone, though this need not be if due care be taken.

When developing with iron it is always a good thing to obtain as strong a deposit as possible, in the first instance ; with some samples of collodion, and in good light a vigorously printing negative can be obtained at once by the iron ; usually, however, the deposit requires some addition to complete the required opacity, and occasionally, especially with short exposures, the first deposit is so very thin and weak, that great trouble is experienced in making a negative having good printing qualities. It should be remembered that all intensifying or strengthening processes have a tendency to produce hardness and destroy half-tone, therefore great care is required in using any of them. There are three stages during which a negative may be intensified—before the yellow iodide of silver is dissolved out ; after the iodide is dissolved and while the film is still wet ; and also after the film is entirely dry.

The following are the most approved methods for intensifying after the picture is developed and before dissolving the iodide out ; first wash the plate thoroughly to remove the iron solution, then pour on the plate a little nitrate of silver solution, strength 20 or 30 grains to the ounce, let it flow backwards and forwards over the plate to mix well with the water on the surface, and then pour over a fresh portion of the iron developer previously used. The developing will begin anew, and if the negative only need a little strengthening this method will quickly answer. The solution may be poured on and off the plate until it becomes muddy, when the operation may be repeated with fresh quantities until the desired density is obtained. This operation must be entirely conducted in the dark room.

Another and better method is to have at hand an—

IRON INTENSIFYING SOLUTION.

Tartaric acid	...	...	...	1 drachm
Protosulphate of iron	...	...	...	1 „
Water	...	...	...	6 ounces.

After the picture has been developed, and all the density obtained that the first developer produces, pour off and renew the developing with the above solution, to which should be added at the time of using a few drops of a plain 30-grain nitrate of silver solution. This soon produces density; in the above solution the tartaric acid prevents the silver being decomposed when added to the iron.

Mr. Valantine Blanchard has proposed

ANOTHER IRON INTENSIFYING SOLUTION.

Protosulphate of iron	...	...	...	1 drachm
Citric acid	...	...	...	2 drachms
Water	...	...	...	12 ounces.

A quantity of this solution may be made up at a time, as it improves by keeping. It is to be used in the same manner as the former one; after the plate is developed by the usual iron solution, pour off and continue the development with this solution, to which some silver solution is added. Pour on and off until the desired density is obtained, renewing with fresh solution and silver if required.

Instead of iron and silver a more usual method is to employ pyrogallie acid in the manner described on page 22. This plan is an excellent one for producing soft yet vigorous negatives, and is one that can be strongly recommended as applicable under almost all circumstances.

Some operators prefer to strengthen their negatives in the second stage, that is, *after* they have dissolved the iodide of silver, and while the plate is still wet. There are several plans of doing this, and those that depend on the reduction of silver must all be done in the dark-room. In all instances the cyanide or hypo must be thoroughly washed away before commencing to intensify.

When only a slight increase of intensity is required, a little silver solution may be flowed over the plate, and the iron developer may be used in the manner previously described. The silver will be thrown down in a grey crystalline powder, which is not favourable to opacity.

A better plan is to use the pyrogallic and silver as in a preceding method, the colour being thus changed to a non-actinic brown, which produces great intensity.

A good intensifier, when the picture does not require much strengthening, is a solution of chloride of gold, 1 grain to the ounce. It has only to be flowed over, and the effect is produced immediately, by changing the previously grey deposit to a nearly black colour.

Bi-chloride of mercury was formerly in great request as an intensifier, it then fell into disuse, and has recently come into favour again. It is very powerful in its action, and requires to be used with great care, as it has a tendency to produce hardness, and to rot the film. These latter defects may, however, be remedied by employing clean glasses, suitable collodion, and by a more sparing use of the bi-chloride itself. A convenient strength is about two grains to the ounce of water. This will form a solution sufficiently strong to serve for all the processes in which it is hereafter alluded to. It should be poured uniformly over the film to avoid stains; it produces its effect in a few seconds, changing the surface of

the negative to a blackish grey. If allowed to remain on long, it would change to a white; this must never be done, or the delicate half-tones will be lost. Wash the plate well, and pour over it a solution of iodide of potassium—2 grains to 1 ounce of water,—which will turn it a dirty greenish grey colour, not pleasant to look at, but an excellent one for printing. If the iodide solution turn the film a bright yellow, the bi-chloride solution is too strong, or has been allowed to remain on too long. The bright yellow colour is nearly useless for printing.

Instead of the iodide, a weak solution of hyposulphite of soda may be poured over, which will change the colour to a rich brown; or a dilute solution of ammonia may be used, altering it to a blackish colour.

Another intensifying solution based on the same principles is composed thus: to a saturated solution of bi-chloride of mercury, add a solution of say 10 grains of iodide of potassium to 1 ounce of water; a red precipitate will soon form, and the iodide solution must continue to be added till it redissolves the precipitate, and becomes clear again. This solution has great intensifying powers, and may be used in preference to those already named, the same precautions being required not to over-do the intensifying.

Another plan for strengthening a weak picture after the iodide is dissolved out, and while the plate is still wet, is to pour over it a solution composed of iodide of potassium 2 grains, iodine 1 grain, water 1 ounce. Allow it to remain on the film about a minute or two, then wash well, and pour over the usual pyrogallie solution, to which a few drops of silver have been added, as if continuing the development. If the required intensity be not produced by the first application, the iodine solutions and pyrogallie and silver may be alternately

used, washing well between, and thus almost any amount of intensity may be obtained, even from a weak negative. The use of the iodine solution is not sufficient itself to produce intensity, but it alters the condition of the film, and enables it to receive a fresh addition of deposit from the pyro and silver solution to be afterwards used.

Some persons prefer, after they have dissolved out the iodide, to let the plate dry before intensifying. Excellent pictures may be produced by this method, but, as there is an increased tendency to produce hardness, the greatest care must be taken. The plate should be thoroughly dried, then the surface well wetted, and any of the intensifying methods already described may be proceeded with; the best effects have, however, been produced by the application of the bi-chloride of mercury solution, succeeded by the iodide of potassium.

With some collodions, the film becomes detached from the glass when re-wetted; in such case, the plate had better be varnished about an eighth of an inch all round with a camel-hair brush before wetting. Benzole, spirit, or black varnish will do.

When bi-chloride of mercury is used as the intensifier, the plates should be allowed to dry spontaneously, as the application of heat sometimes causes the film to break up when it otherwise would not have done so. If the film on drying shows fine crapy lines, especially in the intensest parts, the fault lies in the collodion; it contains too much water, and is not suitable for the process.

All the above methods may be safely relied on for producing the effects attributed to them, but some, especially the bi-chloride ones, require judgment and experience. They must not, therefore, be hastily condemned if the first trial or

two be not successful. Some processes succeed better in one person's hand than in another's, the best plan, therefore, is to adhere to that one which succeeds best, for, after all, the final result depends not so much on the process as on the person who uses it.

TO INTENSIFY NEGATIVES AFTER THEY ARE VARNISHED.

When a negative has been once varnished, its character is supposed to be so settled, that it is beyond the reach of alteration or improvement. It is certainly the best plan to so consider it; yet, sometimes a negative becomes so weakened in the varnishing as to cause great disappointment. It is a consolation to know that a negative need not be given up as hopeless, even under these circumstances. The plan proposed, years since, by the late Mr. Berry, was first to moisten the surface with alcohol, then pour over alcoholic solution of chloride of gold, say five grains to the ounce—the picture quickly blackens and intensifies. The plate may be then washed with plain alcohol, then water, and finally dried. If the surface dries quite dead, the plate may be re-varnished. Should the chloride of gold not give enough intensity, it may be succeeded by a weak alcoholic solution of sulphide of ammonium, which has a great blackening influence on the plate.

Mr. G. Wharton Simpson has recently proposed a very elegant method of intensifying the varnished negative. He first moistens the surface with alcohol, then pours over tincture of iodine diluted to about the colour of sherry. The plate quickly intensifies, and becomes of a greenish tint. Wash the plate, first with plain alcohol, then water, and dry. The plate may be re-varnished, if required.

This method the author has tried with great success, and thinks that many negatives may be improved by this means, that are otherwise of little value.

TO REDUCE THE INTENSITY OF VARNISHED NEGATIVES.

The action of tincture of iodine, in the first instance, is to intensify, as described in the previous paragraph, but Mr. Simpson has shown that if it is long continued, it reverses the effect, it bleaches and makes more transparent the high lights of the negative. To reduce a negative then, the proceeding must be the same as before, but continued much longer, until the dense parts are made of a yellow transparency, which allows the light to pass through. Considerable judgment is required in performing this and the preceding operation, and the methods should never be considered as regular practice, but to be resorted to only in cases of extremity.

ON PRINTING AND TONING, AND HOW TO SECURE GOOD PRINTS.*

ALL other processes are but preparatory steps to printing. For that we make our pyroxyline, prepare our collodion, purchase our apparatus, and rack our brains to produce perfect negatives.

If not the *be all*, printing is certainly the *end all* of our

* A considerable portion of this chapter on Printing is condensed from two papers the author had the honour of reading before the London Photographic Society, and the North London Photographic Association. The writer feels so strongly the importance of good printing, and is so convinced that less depends on the mere materials than on the mode of using them, that he reproduces his urgent remonstrances, convinced that they are almost as necessary now as at the time they were written.

various processes. It is the last crowning stone of the edifice—the very apex of the pyramid.

Yet, with all its importance, we do not do it justice. We vote it a bore; we declare it drudgery, delegate it to our assistant, put it out to be done—employ ignorant men and women, and even children to do it. We hurry it over, begrudge the time, stint the money, use the cheapest materials, and, finally (inconsistent beings that we are) express astonishment that our results are not uniformly of first-rate order.

Note the different degrees of care with which the two halves of the photographic process are conducted! For our negatives we obtain the best glass, prepare it most scrupulously, and do not dare to touch its clean surface; but our boy lets the albumized paper lie about anywhere, and he fingers it and “paws” it all over. Our collodion we pay whatever price the celebrated maker asks for it (so that it be up to the right standard), and we watch and study it as to its age and condition; but we send here and there, anywhere, for our paper, and generally with an eye to cheapness.

We should not dare to keep three or four sorts of collodion, and jump from one to the other, and expect at once to get equally good negatives; yet we employ different samples of paper, treating them all alike, expecting they will or ought to “come out” equally well, and without hesitation, condemn them if they do not answer our expectations. We know that different kinds of collodion require different baths and developers and variable manipulation, but we have yet to learn that different papers require their special treatment too. In our negative baths we use the purest re-crystallized or fused nitrate, but anything will do for printing. We make up one bath with scrupulous care, and most jealously watch its condition, but the other may take care of itself. It is 60-grains to-day, may be

40 to-morrow, and the day after, in a fit of generosity, perhaps is strengthened to 70. This week it is acid, next it may be alkaline : but too generally it may be what it likes and how it pleases.

There are many photographers who really do take pains, and study the production of their prints as carefully as their negatives, and they have their reward; but the majority do not. These latter treat the operation as if it were mechanical, instead of chemical, and the very term "printing," by the association of ideas, helps to confirm the mechanical notion. The letter-press printer bestows all attention on the skilful arrangement of his types, the engraver on the cutting his plate, the lithographer with drawing on his stone, and wood engraver on the block; this well done, the rest is only careful "working off," or "machining." But photography is not mechanical, and will not be "machined." The simile holds good between composing the types and making the negative, but it woefully fails after; for every photographic print is the result of a series of delicate chemical operations, and if the result be not as we wish, we must endeavour to discover where the error creeps in, either by changing the manipulation, or varying the materials. If photographers would but look at prints as chemical, not mechanical products, and endeavour to grasp the causes that produce them, from that moment their prints would be improved and their effects more uniform.

With relation to present troubles, most of them are based upon and grow out of that fatal facility of production that was in use during the sulphur-toning period. It was necessary then only to take the print out of the pressure-frame and immerse it in the inky hypo, and there it remained until it was "done." The present method requires much more care and attention,

and by some this is given grudgingly; they shirk the proper preliminary washings, and, getting into trouble, of course, blame the process. Sulphur, as a toning agent, was not very delicate; much or little albumen, or none at all, it was chiefly a matter of time, and all prints were served alike; whether the paper was thick or thin, English, French, or German, the toning was the same; like a specious, plausible, malignant, destroying demon as he was, his *in-justice* was impartial. But our present protecting genius, Gold, is much more nice and delicate, and recognizes most critically the differences of much or little albumen, of the various kinds of paper, and of minute variations of manipulation.

In the practice of negative-taking, we are not surprised if a goodly number are not first-rate; but our prints, about which we take so little pains, ought all to be perfect. We calculate how much we can get out of a sheet of paper, and expect every square inch to turn out right.

The drift of my observations is to show that we ought not to expect to produce good prints uniformly, unless we take great care, and study attentively the conditions under which they are best produced. If this be done, I am sure we shall fail less often. We must expect less from our materials and more from ourselves. A given method may work well with one kind of paper and not with another. One man may produce uniformly hard negatives, and require a paper to give a soft image; whilst another gets little contrast, and must force it out in printing. In one district the water is soft and pure, in another hard and limy; and shall one formula be applicable under all circumstances, and nothing be left to the skill of the operator? and if the process fails, is the man wholly blameless?

Although the laws of chemistry are regular and certain, yet

who can anticipate, or give directions to another how to act under every emergency? The man who depends exclusively on formulæ, who does not grasp the spirit as well as the letter of instructions, will always be liable to derangements.

The kind of Negative necessary to give a good Print.—The first step towards obtaining a fine print is to get a good negative. This secured, it is surprising how many difficulties are removed. With a good negative, at least passable prints can be obtained on almost any paper, and with any toning process. No one should expect to obtain uniformly good prints, unless he produces good negatives.

This is the very starting-point of success; it is difficult enough to procure good paper and to keep the toning bath in order, without complicating these troubles with the poor and weak images produced from faulty negatives. If a person aims at producing strong and vigorous prints, he must make his negatives with plenty of contrast, or if he wish them to be full of delicate details and half-tone, the negatives must have the same character. It is pitiable to see a man wasting his time and means trying to produce rich black and white tones from weak, thin negatives, capable of yielding only brown or grey tones. Under such circumstances, there is little use in changing the paper or varying the toning—the fault lies in the negative, and there is no evading it. With a good negative almost any depth of tone may be produced by almost any process.

The Necessity of good Paper.—The next most important is to get good albumenized paper. This is not so easy a matter. To produce this article uniformly good seems hardly possible. No two samples of paper from the manufacturer seem ever to be the same, and the source of trouble is more often found there than in the albumenizing.

The paper used to spread the layer of albumen upon is chiefly foreign made. Paper made in this country does not suit the photographer so well as that made abroad.

Distinction between Saxe and Rive Papers.—France and Germany furnish nearly all that is used, and the paper made in these two countries has each its own peculiarities. Neither is a perfect paper. The principal French paper is known as *Rive*, from the place where it is made, and its peculiarities are more or less the same as those of all French papers. It may, therefore, be taken as the type. The German papers are usually described as *Saxe*, though they are made in all parts of Germany, yet the mode of manufacture is very generally the same. *Saxe paper*, therefore, represents that made by a particular method common to a large district, and is indicative of a certain character considerably different from the French or *Rive* paper.

If the English makers would bestir themselves and produce an article having the fineness and hardness of the *Rive*, and the uniformity of texture and absence of metal spots of the *Saxe*, a great boon would be conferred on photographers. Such not being the case, it is for the photographer to avail himself of his knowledge of the peculiarities of these two kinds of paper, and to select which best suits his particular mode of working and his taste.

Rive papers are much harder on their surface than *Saxe*, and the albumen sinks in less, giving, therefore, a more highly glazed face. This is very well adapted for cartes de visite and stereoscopies, but it is not so suited for larger work, as the paper is apt to tear in the washing. Blisters are also more abundant, but the numerous holes and metal spots always found in this paper is one of its greatest objections. The film of albumen seems not to take

so kindly to this as to the Saxe paper, hence there are more streaks and markings; yet with all these drawbacks, this paper is a favourite, in consequence of its brilliancy. Saxe paper is much more uniform in its texture, it has scarcely any of the defects of the Rive, yet the albumen forms a duller surface, and the pictures seem more sunken into the paper. In practice it is much more economical to use, as there is very little waste with streaks, markings, or metal spots. Some samples may be obtained with a much higher glaze than others. The tones yielded by these two papers are rather different. The Rive tends to yield warm browns and purples, the Saxe gives purple blacks.

How to select a good Paper.—In selecting a paper it is a good plan to try a sheet or two of different samples, and of that which is found to answer best, to purchase a quantity to last for a time. The peculiarities of this paper should then be noted, whether it prints best on a 60 or a 90 grain bath, how much overprinting it requires, how far it is to be toned to get the colour wanted, and which toning process suits it best. The information thus gained will make the printing more agreeable and certain, *while that batch of paper lasts*, but the next lot will probably require some other modification. The best albumenized paper the writer has yet used is that made by Schering of Berlin. It may be obtained from some of the regular photographic dealers. It has much fewer of the markings and other troubles, and takes a very nice uniform tone. It has a most unpleasant smell, extremely suggestive of rotten eggs, which is very likely to excite prejudice against it. It is understood that the manufacturer adds something to the albumen, which, while it causes a bad smell, communicates the good qualities for which the paper is distinguished. If the reader is not

satisfied with the paper he is using, he is recommended to give this one a trial.

Sensitizing Solution.—There is no absolute rule as to the strength of the silver solution for sensitizing, although as most papers give good results with 60 grains to the ounce, that may be considered as a standard. Some samples, however, yield better prints on an 80 or 90 grain solution, and with others as low as 45 or 50 grains will do. Generally, one minute floating will be found sufficient on the stronger solutions, and three or four will be required on the weaker ones. The colour of the print in the pressure frame while printing is a good indication whether the silver solution is of the right strength. If it be of a foxy red, the silver is too weak; if a dark purple or bluish purple, it is too strong. There is no advantage, but the contrary, in using the silver solution too strong, for the ultimate print is no better, and this purplish colour misleads in the toning, as it cannot be seen when it has been sufficiently acted upon in the toning bath. A paper that prints a red-purple shows that no excess of nitrate of silver is used, and this colour allows all the changes by the gold to be noted in the toning bath. The use of the silver meter is strongly recommended to prevent anything like guess-work as to the strength of the silver bath. It is best to sensitize the paper the same day it is printed.

Printing, and Washing the Print before Toning.—Some negatives print better in sunshine, others in the shade; generally a weak or thin negative, or one deficient in contrast, gives a better print in diffused light, and a strong, hard negative yields a softer picture if printed in the sunshine. It is impossible to give any rule how much deeper to print than the finished picture is wished to be, as some papers bleach more than others in the toning processes. It is a singular

fact, however, that this circumstance is modified by the nature of the water used for the preliminary washings; rain or distilled water requiring very little over-printing. These preliminary washings are often too much hurried over; they should be carefully done to get all the nitrate of silver out of the paper, and these washing waters should be saved and the silver precipitated by common salt. Many persons experience advantage by adding to the last washing water a little acetate of soda, about 5 grains to the ounce. The print well washed is ready for toning.

Merits of various Toning Baths.—There are several formulæ published, each having its advocates, but one principle is common to them all; they all consist of a solution of chloride of gold, but differ from each other by having some other salt added to it.

It is best to keep the chloride of gold in a solution of known strength (say 15 grains in 15 drachms of water, then each drachm will contain a grain).

Of the three toning baths hereafter described, the “carbonate of soda” is the simplest and most generally used; the “Acetate of soda” the author thinks is the best for all general purposes; and the “chloride of lime” the most unusual and peculiar.

As to the merits of the three formulæ, the “carbonate of soda,” in the author’s opinion, is the least good. The tones are generally some shade of brown, and there is difficulty in avoiding mealiness.

This formula would not be included, but that the author finds many skilful printers using it who adopt it from choice. He prefers the “acetate,” as giving almost every variety of tone, from brown to purple-black, according to the depth of printing and toning. Some subjects look best printed in one

tone, and some in another; and the acetate bath allows a very great variety of tones, and all agreeable ones. It is no small merit that it will keep. The "chloride of lime" bath is a peculiar one—it has but a small scale of agreeable tones, and is so far inferior to the other two. It is the only bath that gives a black and white tone. With good negatives, nice paper, careful printing, and hitting just the tone in the toning bath, the most lovely black and white pictures may be produced. It will be inferred from this that the bath requires great care to produce good results. Such is the case, and, in skilful hands, nothing is so fine for portraiture, but a large margin must be allowed for failures, or, at least, for prints that are not up to the best standard.

CARBONATE OF SODA TONING BATH.

Chloride of gold	...	...	...	1 grain
Carbonate of soda	...	...	...	15 grains
Water	...	...	...	10 ounces.

Make the solution about one hour before using, and prepare only as much as will be used, as it does not keep well.

Print about one-third deeper than is required. Wash the prints thoroughly to remove all the nitrate of silver; the last water should be only slightly milky; do not put them in salt and water as occasionally recommended. This is not only unnecessary but positively injurious, as sometimes an immovable film is formed on the print that always retards the toning, and occasionally stops it altogether.

When the prints are well washed, immerse them in the toning solution, keeping them in constant motion all the time. The first prints soon change colour, let them remain till they are a bluish-purple, then remove them to the fixing solution.

Hyposulphite of soda 3 ounces

Water 1 pint.

Allow them to remain a quarter of an hour, then take them out and wash them well under a running tap for half an hour. Let them remain in water 12 hours, changing the water many times, in fact as many times as possible, for they cannot very well be washed too much.

The hyposulphite solution for fixing must be made fresh each time of using.

ACETATE OF SODA TONING BATH.

Chloride of gold 1 grain

Acetate of soda 20 grains

Carbonate of soda 20 „

Water 10 ounces.

Mix the carbonate of soda and gold first, and then add the acetate of soda. This toning solution should be made an hour or two before wanted, and after being once used will keep well. Print deeper than required, and wash the prints well in several changes of water. These preliminary washings, though needful, are not so important as in the carbonate formula, as a little free nitrate of silver in this bath does not produce mealiness, though it throws down the gold causing waste. The prints must be toned a little deeper colour than they are required to be when finished.

This toning bath produces excellent colours, from a clear sepia to a fine rich purple black, according to the depth they are printed and the extent they are toned. The bath improves by keeping, requiring strengthening from time to time as the gold gets exhausted. It is not a good plan to keep a concentrated solution to strengthen; it is better to make up some fresh at the time, and add it to the old stock. As one grain of chloride of gold will tone a whole sheet of paper

a rich brown, and, two grains a deep purple-black, it can always be calculated how much gold to add to the bath by the number and size of the prints to be toned. Suppose one grain is required for a certain batch, dissolve the gold in one ounce of water, then add to it five grains of carbonate of soda; when dissolved, add five grains of acetate of soda, and then add the whole to the stock solution. It will be observed that the strengthening solution has very little water, and much less carbonate and acetate than in the first made bath; this arises from the circumstance that the bath loses its gold in a more rapid manner than its carbonate or acetate, while the water remains nearly the same. Sometimes the bath becomes inert—it has enough gold to tone well, yet will not. In such a case, add one or two drops only of the stock solution of acid chloride of gold, without any carbonate or acetate. The action will be thus started, and the bath will go all right.

This inert condition is most frequent in baths that have such an accumulation of carbonate of soda in them that checks the tendency of the gold to deposit, but directly the small portion of fresh gold is added, the action is started and then continues. The fresh gold seems to act as a ferment. Chemists have a learned word to explain this, "*catalysis*," but a facetious friend suggests "jibbing" as more understandable and expressive. He compares a bath in this state to a stubborn horse, who will not move until by some means he is compelled to start, and then he goes on all right. Solutions that remain for a time out of use become "jibbers." For this reason it is not well to make up concentrated baths, but the inertia may always be removed by the stimulating action of a very few drops of acid chloride of gold.

The fixing and washing is the same as with the preceding process.

CHLORIDE OF LIME TONING BATH.

Various formulæ have at different times been given out, in which chloride of lime formed an element, and which were supposed to have superior toning properties; but whatever good they may have possessed has been neutralized by the absence of practical details.

The following formula is published for the first time. It has been worked out in the author's establishment, and may be depended on. It is easily prepared, and can be worked at once without any of that waiting for a week, or a month, for the baths to be ready for use, that other formulæ compelled:—

No. 1.

Chloride of lime	...	...	...	$\frac{1}{2}$ ounce
Distilled water	...	...	...	16 ounces

No. 2.

Chloride of gold	...	...	...	1 grain
Carbonate of lime (powdered chalk)	...	...	...	3 grains
Water	...	...	...	1 ounce

Mix No. 1, agitate well, filter, and keep in a stoppered bottle. Into 8 ounces of very hot distilled water put No. 2; agitate for five minutes, then add $\frac{1}{2}$ ounce No. 1, and when cold the toning bath is ready for use. Hot water is employed to make the bath ready for immediate use. If cold water were taken, the bath must remain a week before being used. The bath will improve with working.

Print a little deeper than needed, the depth varies with different papers, for some bleach more than others, and wash the prints before toning. The colours of the prints are colder and bluer while toning than in an acetate bath. In a new

bath the prints must be allowed to become bluer than wished to be when finished. In an old bath, or in a weak, sluggish new one, the prints must be taken out redder than when finished, as in these instances they do not show the extent to which they are toned until they are in the hypo.

The prints must remain in the hypo longer than when the acetate or carbonate bath is used, say, twenty or twenty-five minutes. They become very red on first immersion, and then slowly regain their colour. If they are left in the hypo too long they become weak and flat. When the hypo is too strong it takes out all the rich black colour, and turns the prints a dirty reddish brown.

The tones given by this bath are peculiar. They are a rich black; there is very little purple or agreeable brown. It is therefore well adapted for portraits and copies of engravings, but not for landscapes. The writer in giving his experience with this bath is anxious neither to over or under rate it, but he feels it quite necessary to distinctly state that it requires careful management. For this reason he thinks that the acetate toning bath is far superior for general use, as with it a very considerable range of colour, from light brown to purple black, may be easily obtained. But in the chloride of lime bath there is only one agreeable tone, but that for suitable subjects is very fine. If the toning be stopped before the print arrives at it, when finished it will be a dirty, disagreeable brown, and if carried beyond, it will be a cold, pale, weak slate colour. It is a much more difficult bath to work than an acetate. It requires good negatives, just the proper depth of printing and toning, and a paper well suited to it. With the acetate bath, at whatever stage the prints are taken out of the bath, they are always an agreeable brown or purple tone, but with this bath only one good tone is obtained.

It does not give purple, it passes from brown to black, and then to slate. The author's experience with all varieties of chloride of lime as an element in the toning bath, is, that the tones are always inclined to a cold black, and are sometimes inky and sooty. For this reason he does not think that a chloride of lime toning bath will ever be in general use, as the care required is so much more than with the acetate bath; yet, let it be distinctly understood, for those who are careful and study the conditions necessary, better tones can be produced with it than by any other, but more especially for portraiture.

Advantage of Occasional Variation of Formulæ.—The Author concludes his remarks on the difficult subject of printing and toning with the assurance, derived from an endless number of experiments, that every formula may occasionally be varied with advantage, according to the sample of paper used. The mechanical and chemical nature of the paper, and the chemicals it contains, really form an important part of any printing and toning process. The intelligent printer will, therefore, find much advantage in studying its nature, and adapting his other chemicals to it. It is no use railing against paper, and condemning formulæ; they must both be used, and it is better to try and make them harmonize. Paper cannot be made to suit the chemicals, so chemicals must be modified to suit the paper. Well prepared albumenized paper is one thing, and a good toning process another, and the skill of the printer is shown by blending them so as to produce first-rate prints.

By recommending the use of vigorous negatives, by furnishing good working formulæ, and by urging the propriety of slight modifications, according to circumstances, the key is supplied for producing as perfect prints as the present knowledge of the art permits.

ENGLISH WEIGHTS AND MEASURES.

Troy or Apothecaries' Weight.

20	grains	=	1 scruple
60	"	=	1 drachm
480	"	=	1 ounce
12	ounces	=	1 pound

Avoirdupois Weight.

27 $\frac{1}{8}$	grains	=	1 drachm
437 $\frac{1}{2}$	"	=	1 ounce
16	ounces	=	1 pound

FLUID MEASURE.

60	minims	=	1 drachm	
480	"	=	8 "	= 1 ounce
160	drachms	=	20 ounces	= 1 pint
8	pints	=	4 quarts	= 1 gallon

WEIGHT OF DISTILLED WATER.

At 60° FAHRENHEIT.

1	fluid drachm	weighs	54.7	grains	avoirdupois
1	"	ounce	"	437 $\frac{1}{2}$	" "
1	"	pint	"	1 $\frac{1}{4}$	lb. "
1	"	gallon	"	10	lbs. "

FRENCH WEIGHTS AND MEASURES.

1	gramme	<i>weighs</i>	nearly 15 $\frac{1}{2}$	English grains	(15.433)
1	"	=	10	decigrammes	= 100 centigrammes = 1000 milligrammes
1	kilogramme	=	1000	grammes	= nearly 2 $\frac{1}{4}$ lbs. avoirdupois (2.247)
1	litre	<i>measures</i>	nearly 35 $\frac{1}{4}$	fluid ounces	(35.2)
1	cubic centimetre	<i>measures</i>	nearly 17	minims	(16.896)